kpmg

Project Report

ALBERTA FIRE REVIEW '98

FINAL REPORT

Prepared for

Alberta Forest Protection Advisory Committee

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Executive Summary

In response to the numerous changes that have taken place within the Land and Forest Service (LFS) over the past few years, and in consideration of a record fire season in 1998, the LFS has commissioned a review of the Forest Protection Program in Alberta. This review is important to the LFS from the perspective of maintaining and improving quality service to the public of Alberta and the various stakeholders and industry sectors that are involved in Alberta's forest resources.

The review of Alberta's Forest Protection Program is carried out in two parts. The first part focuses on key program implementation issues that may have effected the outcome of the 1998 wild fire season or that may effect outcomes of extreme fire situations in the future. The second part focuses on the broad program mandate, objectives, policy and structure and addresses many of the program management tools available to implement a fire management program.

The 1998 fire season took shape in prior years. Two years of above normal precipitation (1996 and 1997) resulted in a high level of vegetative build-up of fine fuels and combined with a very dry winter and early spring in 1997/98 to create extreme burning conditions early in the fire season. In addition, fires were experienced in December 1997 in the foothills area of Hinton and Grande Prairie. The result was a fire season that burned over 700,000 hectares across central and northern Alberta, as summarized in Exhibit 1.

Prior to the 1998 fire season, a number of on-going improvement initiatives were being implemented in response to the events of the 1998 fire season. These initiatives were modified or accelerated in 1998 to make the most of the learning opportunities available. The analysis of issues and development of recommendations has been carried out with the understanding that many improvements were already underway that would address concerns arising from the 1998 fire season.

Exhibit I-1
1998 fire statistics

	1998	10 year average	9 year average*
Number of fires	**1,697**	**912**	**825**
Within Forest Protection Area	1,663	900	815
Outside Forest Protection Area	34	12	10
Area burnt	**726,887**	**117,606**	**49,908**
Within Forest Protection Area	709,194	114,589	48,522
Outside Forest Protection Area	17,693	3,017	1,386
Lightning caused fires			
Fire Starts	1,191(70%)	548 (60%)	477 (52%)
Area Burnt (Ha)	651,685 (90%)	106,661 (91%)	46,103 (92%)
Man caused fires			
Fire Starts	506 (30%)	364 (40%)	348 (48%)
Area Burnt (Ha)	75,202 (10%)	10,945 (9%)	3,805 (8%)
Area burnt by region (Ha)			
South East Slopes	778		
North East Slopes	188,438		
Northwest Boreal	220,901	n/a	n/a
Northeast Boreal	348,882		

* *Excludes 1998.*

The program review was based on interviews, focus groups, data collection and analysis, inter-jurisdictional comparisons, and other forms of research and analysis. Interviews and focus groups were carried out with over 140 individuals, including representatives from:

- Land and Forest Service, other parts of Alberta Environment and other government departments.
- Forest, energy and mining industry.
- Railways.
- Towns, Municipal Districts and Counties.
- Supply and service providers.
- Research and planning experts.
- Aboriginal communities.
- A cross-section of MLAs, Ministers and Deputy Ministers.

The key findings from the KPMG review are that:

- The loss of experienced and skilled staff over the years from 1992 to 1998 was a significant factor influencing the outcome of the 1998 fire season. Given the extreme conditions experienced in 1998 and the relatively low availability of experienced fireline staff available to the LFS, a more cautious approach to firefighting was required. Opportunities to more quickly action fires through aggressive and well-coordinated sustained fire action were lost. This issue was focussed in the loss of fire-related experience rather than the overall reduction in SFS staffing level.

- Individuals that worked on fires in 1998 (LFS, industry and imported fireline personnel) rose to the challenge and performed admirably. An excellent safety record was maintained and most people demonstrated a strong commitment to achieving success in fire suppression operations throughout the year.

- A number of tactical, strategic and program issues had an impact on the 1998 fire season:

  - Even though airtanker and rotary wing were brought on for active duty ahead of schedule, availability was below that ideally needed in the early spring of 1998.

  - Diversion of airtankers, aircraft and firefighters to suppress fires in Municipal Districts and Counties placed additional demands on the LFS's fire suppression resources and their ability to action fires within the Forest Protection Area.

  - The excessive reliance on large, centralized base camps without fireline camps affected the ability to put firefighters on the fireline early in the morning and therefore to mount aggressive direct attack.

  - Difficulties with coordination of heavy equipment and communication, (radio availability and protocols for communication between the LFS and forest industry), prevented aggressive suppression action and contributed to a conservative fire fighting approach.

  - There was a high reliance on the Mutual Aid Resource Sharing (MARS) Agreement during the year. This was essential to the LFS's being able to fulfill its mandate.

- The integration of fire management with landscape management is essential for the long-term success of the forest protection program. The Landscape

Ecology Division of Environmental Protection is well positioned to work with fire managers and forest managers in this regard.

- The current organizational structure must change to establish an effective command and control framework within the organization, thus ensuring safety of operations and prompt response to emergency wildfire situations. Structural change is also required to ensure accountability, clear communications and enhanced effectiveness within the forest protection program.

- Recognition of changing environmental factors, (i.e. global warming) is important within the context of policy and program delivery. Jurisdictions across Canada point to earlier fire seasons and more severe peaks.

- Improved relationships with Aboriginal communities will be critical to identifying values-at-risk as well as providing trained and effective fire fighting crews.

* * *

During the course of this review, recommendations for improving the Forest Protection Program were developed. Since the review was carried out in two separate parts, some program implementation recommendations made in Part I were also addressed in a policy sense in Part II. The intent was for the Land and Forest Service to pursue these changes over the next year. A summary of the recommendations follows.

Organizational capability

1. Undertake an immediate investment in people to increase the level of fire certified staff and individuals available for fire duty. This investment should be implemented over the 1999 and 2000 fire seasons by enhancing:

    - Training opportunities for all forest officer and forester staff.

    - Opportunities for all forest officer and forester staff to gain fireline experience.

    - Mentoring relationships between experienced certified fire management specialists and forest officer/ forester staff with an aptitude or potential in fire management operations.

    - Succession planning/management—Identifying individuals with the potential to fill key positions in the future and ensuring that they are given the appropriate training and experience.

    In 1999, the LFS had increased the availability of training opportunities and was making an effort to provide opportunities for all staff to gain fireline experience and obtain higher levels certification.

2. Increase depth with respect to back-up fireline and support positions resources by:

    - Ensuring that all LFS forest officer, forester and selected management staff receive a base level of training with respect to safety, key fire management procedures and common support functions, to enable them to more readily participate in critical fire situations.

    - Actively encouraging companies operating within Alberta's forests to make commitments within their respective fire management plans to maintain training and certification levels appropriate to the size of their operations.

    - Actively developing and maintaining a network of out-of-service fire certified individuals for fireline and overhead positions through seasonal contract opportunities and agreements.

3. Develop training to address the increased desire of the LFS, forest industry and other industry participants to work together during critical fire situations. While some training is already available, industry participants, through the

Alberta Forest Protection Advisory Committee, should indicate what additional training opportunities are needed. Industry sectors should also commit to maintaining a certain level of training within its operations staff—a level to be determined by each company with input from the LFS.

4. Promote mentoring in forest fire management at the local level as a means of providing on the job training linking formal training and real-life application. A senior forest officer, experienced in fire management operations, should be identified and formally assigned a mentoring role for key fire management staff at the local level.

5. Review the guidelines for staff availability during periods of high fire hazard and the degree to which area managers have discretion in adhering to the guidelines. The guidelines should be followed more closely at the forest area level.

Pre-suppression and preparedness

6. Monitor over-winter weather and fuel conditions monthly. Provide formal briefings and data to the LFS executive and Provincial Fire Centre . Preparedness planning in March and early April must reflect this data.

7. Train all Land and Forest Service staff that are involved in the fire management program on the Canadian Forest Fire Danger Rating system and its applicability to fire behavior. Training programs would last approximately one half day and should be offered in the winter of 1999/2000.

8. Schedule completion of all fire line courses before April 15 each year. The only exception to this is training for student crew members.

9. Review the current availability of trained, certified fire fighting personnel by level and identify gaps created by the 1998 fire season and any adjustments to the field fire organization. Target staffing availability need to be created for each level in the fire management organization and a long range plan to deliver the appropriate number of certified fire trained personnel must be developed.

10. The recommendations of the Forest Industry Certification and Training Task Group should be implemented with the forest industry across Alberta:

    - Develop a one or two day fire safety seminar for woodlands personnel, logging contractors, and road building contractors including cat contractors.

- Track the safety orientation for each employee on the LFS FIRES system to ensure compliance.

- Deliver the "dozer boss" course at field locations that would involve all sectors.

- Deliver the "dozer boss" course using LFS certified training contractors or a combination of LFS staff, training contractors and forest industry personnel.

- Involve company employees and contractors in raising an awareness of the fitness standard for dozer bosses and develop a program to help interested individuals to achieve that standard.

- Improve the level of standardization of certification for industry staff and LFS staff, as well as for out of province resources.

11. Develop rotary wing and air tanker contract terms that will allow for start up dates that reflect over winter precipitation and anticipated spring fire hazard indices.

12. Audit the method of capturing tower performance data used in 1998. The goal is to confirm or revise the KPMG analysis that indicates a significant decrease in tower performance.

13. Adjust the criteria for selecting start up dates for towers to allow consideration of over winter precipitation and anticipated spring fire hazard indices.

14. Establish an improved or more rigorous phone in protocol for tower people to facilitate flexible start ups and to support Recommendation 13.

15. Initiate a recruitment and training program to staff more of the lookouts with local people to help facilitate flexible early manning.

16. Implement the AAMDC/LFS, provincially accepted, mutual aid agreement template for MD's and Counties. This agreement more clearly lays out the roles, responsibilities and cost sharing arrangements for forest protection activities.

17. Create a provincial contract or salary position, for liaison with municipal districts on forest protection.

Strategies and tactics

18. Continue to pursue the Line Task Force recommendation—"To test fire fighting shifts such as 0500hrs to 1700hrs and 1000hrs to 2200hrs in the northern areas of the province".

19. Address occupational health and safety concerns with respect to fireline camp arrangements—enabling increased use of fireline camps on sustained action fire campaigns. These concerns or issues include an exemption or modification of key requirements related to:

    - Food preparation at fireline camps.
    - Sanitation.
    - Tents/sleeping facilities.
    - Medical evacuation procedures.

    This recommendation should be pursued at senior executive level between a representative of the department of the Environment and the department of Labour.

20. Develop formal and regular systems for communicating with industry sectors on heavy equipment availability. Develop written protocols or enhanced fire management plans to address procedures to be followed for the coordination and use of industry equipment. Where equipment availability is high, develop dozer units where a single contractor would supply the Cat Boss and machines in each unit supplemented by a skidder or tracked vehicle with water and fuel tanks.

21. Continue the use of burn-outs and emphasize the following factors when planning/implementing burnouts during fire suppression activities.

    - Ensure the big picture is considered when planning burnouts.
    - Use only experienced and qualified staff.
    - Allow for changes to be made to the burn-out plan as conditions dictate.
    - Allow for the participation of the forest industry in planning burnouts when their wood supplies are impacted.

Roles, relationships and communication

22. Actively solicit forest industry assistance and involve forest industry staff in pre-suppression planning.

23. Encourage willing participation of industry staff in providing assistance and pre-suppression planning as required. A certain level of training and time must be invested in woodlands staff to support this initiative.

24. Establish planned communicative relationships at Provincial and Forest Area levels to ensure a comprehensive understanding of the protection program throughout the year.

25. Continue and expand the industry Liaison Consultant program to ensure accurate and timely exchanges of information and participation by industry in the process of forest protection in Alberta.

26. Continue to incorporate industry staff directly within the fire management system in Forest Areas, to ensure timely and expert response to developing fire situations. The two current industry liaison positions are successful and should serve as an example of effective government-industry cooperation and coordination.

Logistics and support

27. Develop the planned enhanced radio network (Alberta Firenet) as a priority in the 1999/2000 fiscal year.

28. Complete a detailed accounting of actual equipment losses in 1998, and a review of 1999 equipment levels is to ensure that equipment inventories are adequate for subsequent years.

Level of protection in Alberta

29. Modify the current set of priorities established for the Forest Protection Program to recognize that:

    - Public safety, communities and homes are first priorities.
    - Secondary priorities will be determined on a fire by fire basis considering all other values-at-risk.

30. Form advisory groups to develop formal definitions and other measures for non-financial values-at-risk. Each advisory group should include local representatives with an interest in the important non-economic values-at-risk specific to each region.

31. Continue to provide a very high level of forest protection across the Forest Protection Area of Alberta recognizing:

    - The large number of communities found in and near Alberta's forests.
    - The very high level of industrial development within the forests.
    - The very high level of timber resource commitment.

    Aggressive initial attack should continue to be the key strategy. It should be the norm for all areas of the province until the LFS has developed and tested a decision process that makes allowances for lower overall values at risk and modified response.

32. Delay any movement towards the use of zoning to guide different levels of protection until the financial and non-financial values-at-risk across the province are fully evaluated including consideration of extensive input from local or regional advisory groups from affected areas across the province.

Level of funding appropriate for Alberta

33. The government of Alberta should increase the level of base funding for forest protection recognizing that the current level is generally insufficient for funding typical fire season costs and that frequent requests for funding are remitted to the Treasury Board each year. An increase in the base budget will not, by itself, add to total forest protection expenditures overall and in fact may decrease suppression costs by supporting a higher level of pre-suppression. There is a need for and benefits from of an increased level of pre-suppression activity given the trend toward longer fire seasons (and therefore increased expenditures) across Canada.

34. Continue funding the Forest Protection Program from the current mix of revenues—forest industry royalties (through the Emergency Fund), forest protection charges, and if there is a shortfall, general revenues (i.e. taxes). Although changes were considered to the level of protection fees charged and the scope of industries required to pay the fee, no change is recommended at this time. However, consideration should be given to reducing protection

charges where companies take direct actions aimed at reducing the risk of loss and improving the speed and effectiveness of response.

Integration of fire management and landscape management

35. Clear direction for the integration of fire into forest resource management and landscape level planning must be provided and must drive the combination of the practices of fire management and forest protection in Alberta. This direction should be provided in the form of a strategic plan or a set of policies and a directional framework that allows for the amalgamation of fire and landscape management. The new Ecological Landscape Division is in an excellent position to meet these needs.

36. Actively manage for fire in Alberta's forests. LFS should incorporate landscape management into forest management and operational planning by:

    - Sequencing harvests based on susceptibility of timber to fire (not necessarily sequencing harvest of oldest timber first).
    - Modifying existing operational ground rules to reflect regional fuel management needs with the use of landscape management tools.
    - Managing the non-commercial landbase as well as the commercially productive landbase to reduce fire susceptibility.
    - Reducing the partitioning of the landscape through industry partnering (i.e. road sharing agreements, coordination of right of way development, timber harvesting activities and improving the integration of operational plans prior to approval).

37. Incorporate fuel management into forest management and operational planning by:

    - Maintaining an inventory of fuel types, amounts and distribution in high valued areas that are susceptible to fire (identified internally or FMA holders).
    - Projecting the effects of operations on the fuel characteristics.
    - Reducing the amount of fine fuels produced from operations such as logging, thinning, right of way construction and other industrial activities.

Organization and structure

38. The LFS should enhance the forest protection organization by creating more direct lines of communication and reporting, by simplifying the command and control structure and by focusing accountability. The enhanced forest protection organization should deliver all prevention, planning, pre-suppression, detection and suppression programs. This involves the addition of staff at the local field level who work within the organization on forest protection related duties full time throughout the year and who report to forest protection managers within the forest protection organization at a regional level. The organization should focus on regional and local program delivery.

    In creating the enhanced organization, the LFS needs to consider reducing the number of "quasi-regional" centres in the fire program from 10 to 4 to:

    - Reduce administrative boundary conflicts.
    - Create clear lines of authority.
    - Focus accountability.
    - Establish a sound command and control structure.

39. In concert with this organizational change, the LFS needs to increase the number of managers and staff at regional and local field locations in order to manage the delivery and administration of the program.

40. Emphasis must be placed on defining the continuing role of all LFS staff in the Forest Protection Program by defining levels of service to the fire program and by maintaining sufficient numbers of certified fire positions to be available in times of need. The new organization should be able to rely on all LFS staff during highly active fire situations.

41. Organizational change should be led by a senior manager and group within the LFS who are dedicated full time to the task of designing and implementing the new organization.

    The move to a new organization must be designed quickly and be operational in a matter of months. Once defined and established, the organization should be allowed to remain stable and relatively free of fundamental change. This stability will allow staff to define roles and mature in their professions.

Relationship with Aboriginal stakeholders

42. Develop a culturally-sensitive communication mechanism to develop input and support for Forest Protection Program initiatives that reflect Aboriginal viewpoints and values-at-risk.

43. Support on-going initiatives to put additional dedicated resources in the Wildland Fire Fighting Units which will serve to facilitate two-way communication locally as well as provide an important organizational tool for coordinating Aboriginal fire crews.

Reducing industry impacts on fire hazard and risk

44. Fuel loading and fuel type changes resulting from stand tending operations must be managed very carefully through a more complete set of policies and guidelines for debris disposal and hazard reduction. These policies should include guidelines for the treatment of fine fuel hazard reduction and consistency across the province.

45. Strictly enforce hazard reduction requirements on seismic line operations, particularly where breaks in the debris windrows are required. A greater use of debris spreading in certain fuel types should be considered as a hazard reduction technique where appropriate.

46. A variable width for powerline right-of-ways should be employed for powerlines located in forested areas. A wider right-of-way can be used when adjacent trees are taller and more mature and narrower right-of-ways can be used through clearings and areas of stunted tree growth. This approach should be addressed at the planning stage for the land disposition application.

47. Place priority on implementing tree freeing plans along powerline right-of-ways. The LFS should work with companies to ensure that tree freeing activities are taking place. To assist, it is recommended that a one day course or seminar be developed for the purpose of educating individuals from power transmission and distribution companies about the standards and practice of identifying danger trees and removing them in a safe manner from the area adjacent to the powerline. Once this one day seminar or course is developed and offered, the LFS and FMA holders should more consistently provide authorization for tree freeing operations where trained and certified individuals are making the decision and taking action to remove danger trees adjacent to powerlines.

The mutual aid resource sharing agreement and Alberta's strategic reserve of firefighters

48. Undertake a review of the WFU I and II crew requirements to meet Initial Attack and PPS need during peak demand periods. From this review, establish thresholds in policy that will be met by Alberta-based crews.

    As a matter of policy, LFS should provide for all of its needs for Sustained Action Crews internally.

49. Increase its WFU I and WFU II crew strength by at least 10% for year 2000. This addition would add four WFU I's and three WFU II's in the first year.

50. Immediately enhance the WFU III program and ensure that at least 3000 WFU III's can be mobilized. This enhancement will require adjusting the contract terms and the input of additional funding to certify and develop the skill sets of these crews in their communities. The current review of the Firefighter Business Strategy will provide further guidance with this issue.

51. Develop incentives for the provision of Initial Attack crews in key areas of FMA's to supplement the provincial crew strength. A reduction in holding and protection charges will help in this regard.

52. Call on the Board of Directors of CIFFC sponsor a national study of crew standards and inventories to address the issue of sharing certified firefighters in a timely fashion under MARS in the year 2000 and beyond.

Environmental factors—climate change and fire regime

53. In partnership with the new "Climate Change Central" (created to study and manage the effects of increased levels of greenhouse gases in the atmosphere), the LFS should support on-going research which uses atmospheric circulation models to study the effects of greenhouse gases, such as carbon dioxide. This research will serve to more accurately record the effect of climate change on the forest and provide the basis for more accurate predictive forecasting of fire season length and intensity.

54. External to the debate on the relationship of greenhouses gases and climate change, the LFS and the Province should accept that forests are responding to a relative change in climate—despite whether this change is within natural climatic variabilities or not. These changes have had and will continue to have real impacts on the costs of forest protection and government needs to adapt

their organizations and budgets to reflect an observed increase in the duration and intensity of fire seasons in Alberta over the past 30 years.

Aircraft management

55. Support the continued development of a turbine powered fire bomber fleet to ensure orderly and timely conversion to more modern aircraft types.

56. Consider transferring management of provincially-owned aircraft and parts from the new department of Alberta infrastructure to the Lands and Forest Service, thereby eliminating duplication of administration.

II

Introduction

In response to the numerous changes that have taken place within the Land Forest Service over the past few years, and in consideration of a record fire season in 1998, the Land and Forest Service (LFS) commissioned a review of its Forest Protection Program. This review is important to the LFS from the perspective of maintaining and improving quality service to the public of Alberta and the various stakeholders and industry sectors that are involved with Alberta's forest resources.

This is a major review of the province's Forest Protection Program with a goal of improving the program. Its goal is to improve the overall program based strongly on findings from data analysis and discussions with representatives from government, the forest industry, oil and gas industry, mining industry, major utility companies, railroads, counties and municipalities as well as affected aboriginal communities.

The terms of reference directed the review team to address some very specific items. Broadly speaking, these items are separated into two parts. The first focuses on key program implementation issues that effected the outcome of the 1998 wild fire season or that may be factors affecting extreme fire situations in the future. The second focuses on the program mandate, objectives, policy and structure and addresses many of the tools available to manage a fire protection program. Specific deliverables from the review are summarized as follows:

Part I of the program review addresses the following specific areas:

- Identification of existing goals, objectives, policies and performance measures for each of the four major disciplines (prevention, detection, pre-suppression and suppression) and for each sector operating within Alberta's forests.
- A review of program structure and implementation issues that may have contributed significantly to the wildfire situation.
- A critique of certain strategies and tactics commonly used and specifically used in the 1998 wildfire season to evaluate their impacts.

- The identification and description of new initiatives for improvement that were underway in 1998, that are currently underway, and that are planned for introduction and implementation in 1999 or 2000.

Part II of the review addresses the following:

- A review of several important wildfire management policy areas including:
  - The level of protection appropriate to Alberta's forest and wild lands.
  - Determination of fire management priorities based on values at risk.
  - The type and extent of involvement by other interests operating in the province's forested areas.
  - The use of fire management agreements as a tool for bringing other sectors into the Forest Protection Program.
  - An evaluation of the funding of the Fire Management Program with respect to funding sources and funding mechanisms.
  - The impact that industrial operations have on important aspects of fire management, such as fuel availability, fuel continuity and fire spread rates.
- A review of communications as part of the Forest Protection Program both within government and between government and its stakeholders.
- A review of overall policy related to forest protection including such key items as: goals, objectives and performance measures, levels of protection and priorities, fire control agreements with other parties, finances, industrial operations, communication approaches and techniques.
- Development of a formal annual review process to account for performance measurement and new initiative tracking for those sectors directly involved in the Forest Protection Program delivery.

The approach taken in reviewing the Forest Protection Program involved a combination of interviews and focus group sessions with stakeholders, a detailed review of available information on the program, and a critical analysis by experts in the areas of program structure and efficiency, wildfire management and forest management (among others). Over 140 people provided input through interviews and focus groups. A list of contributors and interviewees is provided in Appendix A.

Part I of the review was carried on between April and July of 1999. Part II was carried on between July and November 1999. The review was not intended to address activities or items in 1999, however the severe fire season 1999 clearly raises new issues and provides greater insight. This final report is a compilation of work carried out in two distinct phases. While there is some overlap between the two parts, every effort is made to minimize duplication while retaining the essence of the analysis.

Part I

Program Implementation Review

III

Description Of The Forest Protection Program

A. Mandate, goals and objectives

Forest protection in Alberta is delivered through a very well-defined program that has been in existence since the province first took on responsibility for the management and allocation of natural resources. Forest Protection has always been a core responsibility area within the province's natural resource management mandate and has evolved over time to match the needs of Albertans, changes in technology and improvement in organizational capabilities.

As it currently stands, the province has established mandates, goals, objectives and performance measures for forest protection through legislation, regulation, policies, procedures and business plans. In addition to the policy structure of the Alberta Land and Forest Service (LFS), the sectors involved in Alberta's forests have their own objectives and performance measures. Exhibit III-1 summarizes the mandate, goals and objectives and performance measures of the Forest Protection Program as it relates to the four primary disciplines (prevention, detection, pre-suppression and suppression) within the Forest Protection Program. The following sources were investigated to obtain this information:

- Forest Act.
- Forest & Prairie Protection Act.
- Forest & Prairie Protection Regulation (Parts I and II).
- Environmental Protection Business Plan.
- Environmental Protection Annual Report.
- Land and Forest Service Business Plan.
- Interviews with departmental and LFS executive management.

Most of the information regarding mandate, goals, objectives and performance measures is found in the LFS Business Plan.

Exhibit III-1
Mandate goals, objectives and performance measures of the Land and Forest Services

	Prevention	Detection	Pre-suppression	Suppression
Mandate	• To develop and implement programs to reduce the occurrence and significance of man caused fires.	• To develop and maintain an effective detection system.	• To develop and implement a system of preparing for fire suppression activities.	• To develop and implement systems for effective initial attack and sustained action on wildfires.
Goals/objectives	• To reduce the numbers of man caused forest fires. • To reduce the severity or significance of forest fires.	• To promptly detect fires. • To provide information to assist with decisions regarding initial attack resources.	• To prepare and position resources in an optimal manner to minimize response time to new wildfire starts. • To ensure adequate resources are available when needed for fire suppression activities.	• To control and extinguish wildfires as quickly as possible. • To keep losses due to fire at an acceptable minimum.
Performance measures	• Maintain the number of person caused fires in the Forest Protection Area at 0.18 fires per person residing in the province.	• Detection of 100% of wildfires at a size of 0.1 hectares or less.	• 100% of successfully detected wildfires actioned before reaching 1.2 hectares in size.	• 100% of fires held before the second burning period. • Annual burn area kept below 1/10 of 1% of the land under protection.

The policy framework for the overused in various ways industrial and public sectors involved with Alberta's forests exists primarily through legislation, regulation and terms of forest and land tenure agreements. Legislation does not formally oblige any industry or public sector to manage or suppress fires. It requires reduction to the risk and hazard of wildfire.

The mandate of other public and industrial sectors in forest protection can be defined as "following the requirements and serving the intent of legislation, regulation or applicable fire control agreements". The inferred goals and objectives, mirror those of the LFS. The sectors also have their own emergent goals and objectives that relate to their interests.

These have been summarized from interviews and reviews of company fire management plans as those items in Exhibit III-2, though they are not expressed in any formal strategic document for the industry sectors as a whole.

Exhibit III-2
Goals and objectives

Industry sector	Inferred goals and objectives
Forest industry	• Protecting timber resources, including standing timber, decked timber, annual allowable cut and plantations. • Protecting infrastructure and facilities. • Managing for landscape level forest management objectives. • Managing for fire management requirements, including fuel breaks, ground access, water sources and helicopter access.
Energy industry	• Protecting installations and facilities. • Protecting pipeline crossing from heavy equipment.
Railway industry	• Protecting rail lines and maintaining access. • Minimizing disruption to the movement of cargo.
Mining industry	• Protecting facilities and equipment.
Utilities	• Protecting powerlines and installations. • Minimizing fire starts associated with power line interferences (i.e. tress falling on power lines).
Municipal districts and counties	• Public health and safety. • Protection of private/public property and infrastructure. • Minimization of public disturbance.
Aboriginal communities*	• Public health and safety. • Protection of private/public property and infrastructure. • Minimization of public disturbance. • Management or protection of traditional use areas.

** As additional interviews and focus groups are required with aboriginal communities, additional goals and objectives may be determined.*

B. Resources committed to the program

Forest protection programs are highly dependant on the availability of three categories of resources at critical times—trained and certified people, specialized equipment and funding.

Trained or certified people are the backbone of Alberta's Forest Protection Program. Human resources required for the program cover a broad spectrum of needs, ranging from support functions to front-line firefighters and qualified leaders/decision makers within the fire line organization. Specialized equipment required for the program ranges from fire line tools to rotary wing aircraft, air tankers and heavy ground equipment. The availability

of funding at critical times over the fire season is key since the amount and cost of services required to support sustained wildfire suppression action can be very high. Funding is required to support expediting services, camps and food, general supplies, transportation and numerous other goods and services.

A full description of resource commitment and availability requires data from 1998 with respect to certified positions and staffing levels, which has not been available from the database systems that support the Forest Protection Division. The required data is being pursued through other sources.

C. Major forest protection activities

The major activities associated with the Forest Protection Program can be broken out into the four categories of fire prevention, detection, pre-suppression and suppression. A fifth category or discipline is emerging out of fire prevention that addresses the issues associated with the interface between wildland forests and urban development. At this point, wildland/urban interface programs are still included in the prevention discipline. Exhibit III-3 presents an activity matrix of activities carried out by the LFS and selected industry sectors.

Exhibit III-3
Fire management general activity matrix

	Pre-suppression	Prevention	Detection	Suppression
Forest industry	• Willing assistance to LFS. • Some localized equipment, staff, training. • Protection plans. • Open communication. • Will locate and make ready heavy equipment and / or other equipment. • Develop fuel breaks, access, helicopter landing sites and water sites.	• Consider role to be assistance. • Some participation in "partners in protection". • Internal promotion of prevention techniques. • Will curtail forest activity during high hazard.	• Will report fires as discovered on their lease. • Occasional assistance for detection patrols on request. • Primarily an LFS function.	• Primarily an LFS function. • Will take initial action wherever possible. • Assist whenever possible. • Participate when requested. • Provide key area information.
Energy industry	• Limited involvement in pre-suppression planning. • No company protection plans. • Limited equipment on site. • Some response plans outlining company priorities and equipment on site.	• Assist LFS by providing information. • Limited vegetation control. • Some controlled burns. • Information shared with staff. • Reduction of flaring during spring time and times of high hazard.	• Considered an LFS responsibility. • Will watch for and report fires.	• Primarily an LFS responsibility. • Will take initial action if possible. • Provide assistance with people and equipment when requested.
Railways	• Provide contact lists. • Will provide assistance. • Some equipment and available crews. • Supply of water tank cars.	• I/D major ignition sources. • Controlled burns and mechanical fuel reduction. • Spark reduction techniques and arrestors.	• Considered an LFS responsibility. • Instruct trainmen to stop periodically to inspect gear and watch for fires on the right-of-way.	• Initial action small fires. • Contact fire departments in white zones, LFS in green zones. • Will move people and equipment to assist LFS.
Mining industry	• Limited involvement in pre-suppression planning. • No company protection plans. • Limited equipment on site. • Some response plans outlining company priorities and equipment on site.	• Assist LFS by providing information. • Limited vegetation control. • Some controlled burns. • Information shared with staff.	• Considered an LFS responsibility. • Will watch for and report fires.	• Primarily an LFS responsibility. • Will take initial action if possible. • Provide assistance with people and equipment when requested.
Utilities	• No direct involvement in pre-suppression planning. • No company protection plans. • Limited equipment on site.	• Assist LFS by providing information. • Vegetation control. • Some controlled burns. • Information shared with staff. • Management of right-of-way hazard and risk.	• Considered an LFS responsibility. • Will watch for and report fires.	• Primarily an LFS responsibility. • Will take initial action if possible. • Provide assistance with people and equipment when requested.
Municipal districts and counties	• Willing assistance to LFS. • Some localized equipment, staff, training. • Protection plans. • Open communication. • Will locate and make ready heavy equipment and / or other equipment.	• Some participation in "partners in protection". • Internal promotion of prevention techniques.	• Will report fires as discovered. • Occasional assistance for detection patrols on request.	• Responsible for fire suppression within MD/county boundaries except unoccupied Crown land in the Forest Protection Area. • Enters into Mutual Aid Agreements with LFS.
Aboriginal communities	• Willing assistance to LFS. • Protection plans in some cases. • Open communication.	• Vegetation control and some controlled burns sponsored by LFS.	• Will report fires as discovered.	• Department of Indian and Northern Affairs responsible for forest protection within Indian reserves. Fire Control Agreements are in place between the Province and DIAND for forest protection services. • LFS provides forest protection services on Metis settlements.

D. Funding and annual expenditures

The Forest Protection Program involves extensive expenditures incurred to allow for the positioning and use of human resources, specialized equipment and other goods and services as required for the program. The sources of funding and specific financial policies associated with funding the Forest Protection Program have evolved over many years and has reached a relatively advanced state of development. Provincial funding for the Forest Protection Program is organized into three different parts:

- A base level of funding is provided through the appropriated base budget. This amounts to $35 million per year for fire suppression and insect and disease programs exclude forest pest management.

- In addition to the base budget, an additional $10 million is available to the program if required to support additional fire control work that is required over and above the base amount planned for in the annual business plan due to unforeseen circumstances. This additional funding is essentially a "pre-approved expenditure" from the Environmental Protection Emergency Fund (EPEF).

- If the $12.5 million pre-approved emergency fund limit is not adequate to meet program needs, further funding is available from the Environmental Protection Emergency Fund with the amount is determined on an "as-needed" basis. Access to this money must be approved by cabinet upon recommendation by the Minister.

- The base budget is funded from government's general revenue fund through an appropriation and is identified and accessed in the same way as all other departmental funds. The Environmental Protection Emergency Fund receives its funding from the following sources to a maximum of $150 million.

  - Timber dues.
  - Holding and protection charges.
  - Export quota fees.
  - Payments from the federal government related to Indian Reserves and Department of National Defense protection agreements.
  - Other departmental revenues.

In addition to these public funds, other sectors in participate in and fund the Forest Protection Program. These amounts are small compared to the primary sources of Environmental Protection's appropriated budget and emergency fund. They include:

- Company or industry expenditures under fire control agreements or internal programs.
- Funding through the Forest Resource Improvement Association (FRIAA) that augments pre-suppression and preparedness status during the fire season.
- Municipal districts' and counties' fire suppression activities.

Annual public expenditures on the Forest Protection Program vary greatly from year to year, reflects the fire hazard and wildfire occurrence experienced. Exhibit III-4 summarizes expenditures since 1988.

Exhibit III-4
Annual expenditures in the Forest Protection Program since 1988

Year	Expenditure ($ million)	Cost per ha ($)
1998	242.0	6.16
1997	35.5	0.90
1996	44.4	1.13
1995	73.6	1.87
1994	47.7	1.21*
1993	47.6	1.24
1992	52.3	1.36
1991	49.4	1.28
1990	71.0	1.84
1989	42.9	1.11
9 year average to 1997	51.6	1.39
10 year average to 1998	70.6	1.80

** Forest protection area changed in 1994, affecting cost/ha.*

1998 was a year of extremely high spending—a response to the high hazard experienced throughout the year, the number of hectares burned and the values at risk. Expenditures in 1998 also reflect cost items not included in past years such as post fire reclamation and reforestation, airport upgrades and systems development.

IV

Description Of The 1998 Fire Season

A. Fire weather and hazard

The setting for the 1998 fire season began in 1996 and early-mid 1997 as above normal precipitation resulted in a build-up of fine fuels. Due to the arrival of El Mino, or global weather pattern affecting western Canada and the U.S., very low amounts of precipitation were experienced throughout west-central Alberta and northern Alberta in the fall and winter of 1997/98. Wildfires were encountered as early as December 1997 in the foothills near Hinton and Grande Prairie. Low moisture levels, cured grass, high winds, and low relative humidities combined with a man caused fire-start to burn 500ha of forest within the Weldwood FMA. Exhibit IV-1 shows the below normal participation experienced over the 1997/98 winter period.

An early spring that was hot and dry added to the fire hazard, contributing to very high starting drought codes indices. The hazard experienced early in 1998 was unprecedented. Exhibit IV-2 shows the drought codes in place on April 28, 1998. Drought codes were much higher than normal for most of the province. Exhibit IV-3 shows the rapidly building fire danger rating early in the year.

Exhibit IV-1
1997/98 over winter
precipitation anomaly

Exhibit IV-2
1998 spring drought codes

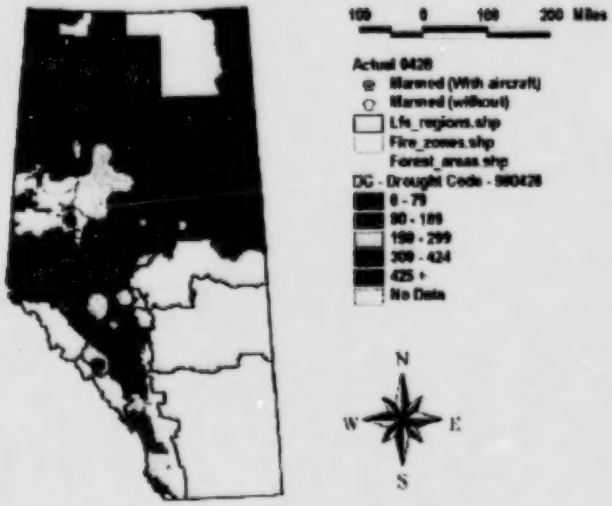


Exhibit IV-3
Early 1998 fire danger rating

Selected dates	Fire danger rating
April 28	Moderate
April 30	High to extreme in flashy fuels
May 1	Extreme in flashy fuels
May 2-5	Very high to extreme across the province
May 6	Northern Alberta low; extreme in Swan Hills and the North East Slopes region; very high elsewhere
May 7 and thereafter	Very high to extreme in the North Eastern Slopes region

Source: Land and Forest Service

B. Fire occurrence

The result of highly unusual weather/climate patterns and the resultant high fire hazard in the spring of 1998 was an unprecedented number of fire ignitions and area burnt. Exhibit IV-4 shows the fire statistics describing numbers, areas and status of fires experienced early in 1998. Exhibit IV-5 shows the final fire statistics for 1998.

Exhibit IV-4
Early 1998 fire situation

	Protection area				Non-protection area			
	Number of fires to date		Area burnt to date (ha)		Number of fires to date		Area burnt to date (ha)	
Selected dates	1998	5 yr. avg.	1998	5 yr. avg.	1998	5 yr. avg.	1998	5 yr. avg.
April 8*	9	0	67	0	0	0	0	0
April 14*	16	7	117	27	0	0	0	0
April 20*	45	16	529	99	2	0	2	0
April 21*	63	18	654	121	3	0	57	0
April 24*	90	24	651	126	6	0	192	0
April 27*	105	27	1,142	132	6	0	192	0
April 29*	128	28	1,331	132	7	0	193	0
May 1*	151	29	1,351	142	7	0	193	0
May 2	163	65	1,709	454	8	0	223	0
May 3	184	69	7,793	492	11	0	400	0
May 4	228	72	13,191	528	11	0	400	0
May 5	242	74	40,850	580	13	0	432	0
May 6	248	81	152,247	590	13	0	432	0
May 7	255	89	156,201	608	13	0	432	0

* *5 year average not available - 1997 data used in lieu of five year average for these dates.*

Exhibit IV-5
1998 fire statistics

	1998	10 year average	9 year average*
Number of fires	1,697	912	825
Within Forest Protection Area	1,663	900	815
Outside Forest Protection Area	34	12	10
Area burnt	726,887	117,606	49,908
Within forest protection area	709,194	114,589	48,522
Outside forest protection area	17,693	3,017	1,386
Lightning caused fires			
Fire starts	1,191(70%)	548 (60%)	477 (52%)
Area burnt (ha)	651,685 (90%)	106,661 (91%)	46,103 (92%)
Man caused fires			
Fire starts	506 (30%)	364 (40%)	348 (48%)
Area burnt (ha)	75,202 (10%)	10,945 (9%)	3,805 (92%)
Area burnt by region (ha)			
Southeast slopes	778		
Northeast slopes	188,438		
Northwest boreal	220,901		
Northeast boreal	348,882		

* *Excludes 1998.*

The 1998 fire season was well beyond any typical fire season for Alberta in terms of the numbers and timing of fires. Weather and fire weather indices were not experienced in the same combination before, which posed an unprecedented challenge to the Land and Forest Service.

V

Ongoing Improvement Program

Prior to the 1998 fire season, the Forest Protection Division had an ongoing improvement program to help meet the changing demands and incorporate new technology and ways of doing business. A number of initiatives associated with the continuous improvement program commenced prior to the 1998 fire season while others were implemented during the fire season or were scheduled for the winter or summer of 1999.

A review of these initiatives is important as some of the concerns or recommendations identified during this review may have already been dealt with. In addition, some of these initiatives might be supported, fine tuned or changed based on the lessons learned from 1998. In this chapter we list and describe the initiatives commenced under the ongoing improvement program.

A. Reviews

The Forest Protection Division is actively reviewing its programs—other than this work, the initiatives underway include a financial review, a review by the auditor general and several specific focused projects led by operations task forces. The intent is to identify areas in need of improvement and changes to be implemented that would help the program better achieve its objectives. The financial review and the review by the auditor general also address specific compliance requirements related to financial control and accountability.

The focused reviews led by operations task forces were organized to take advantage of the learning opportunities that emerged from the 1998 extreme fire season. They are listed in Exhibit V-1.

Exhibit V-1
Task groups

- Line task group
- Plans task group
- Service task group
- Fireline equipment
- Foam task group
- Aircraft management
- Fireline certification
- Heavy equipment
- Aerial ignition
- Forest level fire impacts (integrating forest and fire management)
- Presuppression preparedness planning
- Fireline safety officer
- Fire costing
- AAMDC & LFS
- Wildland firefighting units
- Fire investigation
- Provincial training
- Fire centres

B. Fire fighter business strategy

Land and Forest Service is establishing sustained action unit contracts in parts of the province. Sustained action units are fire fighting crews trained and ready for sustained fire duty, but are also employed for work throughout the season on functions other than fire suppression if the hazards and fire activity dictate.

The advantage concept is that by keeping a crew together throughout the fire season, a higher level of performance on the fire line can be achieved through ongoing training, readiness and team building exercises. As part of this initiative in 1998, three level 2 sustained action units were established through non-competitive bids. In preparing for 1999, an additional six competitive bids were tendered, and 11 were awarded to sustained action crews without competition. The strategy is being reviewed and improvements are made with input from fireline staff and the crews themselves.

C. Outsourcing supply and service

Man-up and sustained fire suppression action requires a high level of support for fire fighting crews and to maintain the organization's readiness. The logistics and resources required to supply and serve these crews is complex and at times difficult. Outsourcing these functions to organizations that specialize in the supply and service industry may help

the forest service to concentrate on what it does best—setting priorities, making decisions and commanding action. Areas being outsourced include:

- Base camps.
- Line camps.
- Security—at camps and around equipment.
- Fuel.

This initiative was being put in place by the 1998 fire season and since then, reviews of the results have been taking place to continually improve the practice of outsourcing.

D. Forest Protection Advisory Committee

In order to promote increased cooperation and communication between the industries that work in Alberta's forests and the LFS, a Forest Protection Advisory Committee was established in 1996. In turn, this committee struck a number of sub-committees—forest industry, municipal and fire review sub-committees.

These were charged with the responsibility of dealing with specific issues or action items that the Forest Protection Advisory Committee needs addressed.

Interest in the Forest Protection Advisory Committee was minimal over the years from 1996 to 1998. After the 1998 fire season, this group has been highly active. The committee has no formal authority, though it is useful to the LFS as a means of involving the industry and public in the Forest Protection Program and for improving communication.

E. New technology

Technology has been an important aid to fire fighting. It can contribute to increased performance and protection. New technology currently being developed and implemented includes:

- Fire Information and Resource Evaluation System (FIRES).

- Spatial Fire Management System (SFMS).
- Resource Tracking System/Air Tanker Dispatch (RTS/AT dispatch).
- Inventory Management Information System (IMIS).

F. Firenet

The firenet initiative is an upgrade of the fireline radio communication system to enhance communication capability, and improve resource deployment and coordination. The key component of this initiative is the reintroduction of VHF radio communications to the fireline communications system. The firenet initiative will help decrease the amount of time required to assemble and place resources in fire situations.

The LFS identified this as a priority initiative and has taken steps to upgrade the existing system, but it has recently experienced some funding issues. They are dealing with the funding shortage.

G. Air tanker conversion

Air tankers age and become expensive to maintain, less reliable, and less able to meet specific needs. In 1999, Alberta converted one B-26 tanker group to a CL-215 tanker group, and one DC-6 tanker group to an AT-802 tanker group.

Airtankers are described as follows:

- B-26—mid-size tanker with 4,500 litre capacity.
- DC-6—large tanker with 11,000 to 12,000 litre capacity.
- CL-215—skimmer tanker for use on lakes.
- AT-802—smaller turbocharged tanker with 3,000 litre capacity.

H. Airport upgrades

Airports are being upgraded to handle existing air tanker requirements and to provide the flexibility to handle larger air tankers in the future. In 1998 the air tanker bases at Rocky Mountain House, Pincher Creek and Rainbow Lake were upgraded. Air tanker base upgrades being carried out in 1999 and 2000 include High Level, Steen River and Loon River.

I. Reorganization

As a result of problems experienced in the 1998 fire season and in an effort to focus additional attention on the pre-suppression preparedness and initial attack functions across Alberta, ten fire centres have been established at strategic locations. Full-time dedicated staff, including ten forest protection officers and ten forest protection technicians, are assigned to the fire cities. In addition, all air tanker dispatch has been centralized at the Provincial Forest Fire Centre and a wildland fire prevention section has been re-established at the PFFC to promote and encourage prevention activities.

Fire prevention is being given an increased level of status and stature in an effort to reduce the number of man caused fires and to reduce the potential damage caused to private property in the event of wildfire on the wildland urban fringe. The fire prevention initiative largely involves education, engineering and enforcement (the 3 E's of prevention).

J. Landscape fire management

The integration of fire and forest management planning is a longer term initiative. It requires a new way of thinking for those involved in forest protection and managing timber resources—a very broad, long term view of forest management and the values that the forest has to offer. Issues arising from this include the protection of communities, use of prescribed fire to achieve landscape level objectives, and flexibility in managing and modeling timber supplies.

K. Training

Training is an essential part of improving performance and better achieving results. New courses are being offered in fire management in 1999 include:

- Use and Application of the Spatial Fire Management System (SFMS)—to help implement this enhanced package priority setting and resource deployment.

- Use and Application of the Resource Tracking System (RTS) and Airtanker Dispatch System (ATD)—to implement inprovements aircraft management and dispatch.

- Use and Application of the Inventory Management Information System (IMIS)—to improve the tracking and controlling of equipment and supply inventories.

- Helicopter Management—to improve the utilization of rotary wing aircraft on fire operations.

- Fire Investigation—to enhance the department's capability of determining the cause of fire starts and applying charges where appropriate.

In addition, other training vehicles are being developed for existing courses, for example, CD-Roms on fire safety, videos on forest health training and physical fitness, and written manuals.

L. Industry relations

The 1998 fire season exposed the need for improving communications on forest protection between the Land and Forest Service and industry sectors operating in Alberta's public forests. Specific initiatives aimed at improving relations include establishing an industry liaison position on overhead teams during wildfire suppression activities, and ongoing industry liaison positions in two regions.

The liaison positions were initially established to coordinate and provide input from the forest industry. The role has expanded to include work with the oil and gas, mining, rail and utility industries, municipal districts and Counties. In addition to these two key initiatives, industry training and the establishment of an integrated pest management working group has helped to build bridges between the industry sectors and the LFS.

M. Other initiatives

Other initiatives have been identified:

- Developing relations and agreements with counties and municipal districts.
- Addressing issues specific to power lines and the cooperation of utilities companies.
- Participating in a northwest fire "compact"—a resource sharing agreement with north western jurisdictions in the United States and Canada (Alberta, British Columbia, Yukon, Washington, Idaho, Montana, Oregon and Alaska).
- Updating policies and manuals.
- Upgrading selected fire equipment.

N. Forest health

Forest protection involves more than just fire control—it involves protecting our forests from insects and diseases. Initiatives related to forest health include:

- The control of spruce budworm.
- Dealing with wood borers in fire kill timber.
- Managing mountain pine beetle threats.
- Controlling restricted and noxious weeds where required.

VI

Organizational Capability

A. Introduction

Organizational capability is a combination of human resources, information and tools and systems. In this section, we deal with the human resources aspect of organizational capability, which can be described as a combination of staff experience, staff training and key skill sets that contribute to a team's ability to achieve its objectives.

Capability is related to the individuals that are on the team as well as the organizational framework under which they are expected to perform. It is not solely a function of the number or type of positions identified. Contributing factors include:

- Individual and organizational experience.
- Training.
- Mentoring.
- Career paths.
- Leadership.

Capability is not a black and white issue—it exists on a continuum of organizational effectiveness ranging from less than optimum to best practice. Organizations need to strive for a level of competency that is optimum for their situation—essentially a cost/benefit relationship. In analyzing organizational capability, the main objective is to identify areas that play key roles in achieving organizational objectives and finding ways to improve performance or potential performance.

B. Background

Since 1993, the province had placed a priority on restructuring and downsizing government. Government was becoming more business like in its approach to managing the province's finances and was focusing on the key areas of accountability, business planning, and performance measures. The main thrust was in deficit and debt reduction and the maintenance of a smaller and more accountable government. This affected each department in terms of staff reductions, reduced funding, and program delivery systems.

All departments were affected by this new government focus. Line agencies, such as the Department of Environmental Protection, were particularly affected in terms of human resources because their budgets had a relatively high salary component to it. All departments were expected to contribute to the downsizing and expenditure reduction targets—Environmental Protection contributed its fair share to the program.

Staffing levels have decreased each year within the Department of Environmental Protection, including the Land and Forest Service (LFS). For over 6 years all staff reductions were made through attrition and voluntary severance. The most significant effect of budget cutbacks and staffing reductions on the Land and Forest Service was the loss of experienced Forest Officers and Foresters to other employers and other jurisdictions and to early retirement buyout incentives. Many of these forestry staff members were trained and skilled in fire control and had formed an integral part of the forest protection program.

In addition to staffing reductions, a number of changes were experienced across government in terms of human resource management including compensation, recruitment, restructuring and career opportunities. There has been much discussion, both within and outside the context of this review, about the impacts of these changes on the capability of the LFS to deliver an effective fire management program. This review does not assess the decisions made in relation to government restructuring, nor is it intended to evaluate the strategic direction of government generally. The purpose of evaluating specific changes over time is to gain an understanding of organizational capability in 1998 and what opportunities may exist for improvement.

C. Issue analysis

Over the course of our extensive interviews and focus group sessions, a number of issues related to organizational capability were raised by government staff and the various industry stakeholders. Comments and concerns related to organizational capability were

primarily raised by Land and Forest Service staff and Forest Industry representatives—other government people and industry sectors did not raise these type of issues to a significant extent.

The common theme among the organizational capability concerns and issues expressed is the belief that reduced staffing levels and other staffing issues affected the performance of the LFS during the 1998 fire season and therefore affected the outcome of the fire season in terms of area burnt and values lost. Specifically, the following key issues encompass the range of concerns and views expressed during interviews:

1. Shortage of LFS staff—There is a wide-spread perception that there were simply not enough people within the LFS to deliver the program at the level and intensity needed. While most understand that it is impossible to maintain a staffing level that is adequate for all conceivable conditions at all times, many people believe that the reductions experienced by the LFS may have had a significant impact on the results achieved in 1998.

2. Inexperience of staff in key roles—It was generally felt that at all levels in the forest protection program, there were cases of individuals being expected to fulfill responsibilities that were beyond their experience and training levels and that this impacted the effectiveness of suppression activities. It is widely believed that a more aggressive strategy may have been employed with more experienced people at the various key positions, which would have mitigated losses experienced through the larger wildfires.

3. Incomplete training—The early start to the fire season put significant pressure on the spring training program. A common concern expressed is that a number of training programs were suspended or not completed and that this resulted in fewer people being available for fire duty with the proper safety and leadership skills than normally would be the case. It was generally felt that this impacted the effectiveness of fire suppression activities.

4. Availability of district staff—In some instances it was noted that district staff were not immediately available for fire duty as dictated by the hazard due to scheduling inefficiencies. It was felt by a few individuals, who were aware of these scheduling issues, that this specific issue may have had an impact on the effectiveness of fire suppression activities early in the fire season.

5. Acceptance of change—Some individuals within the program have not accepted or adapted to the changes that have taken place within the LFS. It has been suggested by a number if people interviewed that this resistance to

change has affected morale and commitment to the objectives of the forest protection program and that this may have lead to suboptimal performance in fire suppression activities.

6. Exhaustion in key positions—A number of individuals were worked for very long periods of time and for very long hours each day. It has been pointed out that their ability to produce and make decisions may have been compromised due to circumstances beyond their control and that this may have impacted the results of the 1998 fire season.

Each of the above key issue areas derived from interviews and focus groups has been evaluated to determine whether or not there is a deficiency within the forest protection program with respect to these specific concerns. Supporting data is presented and conclusions and recommendations are offered for each issue area evaluated.

1. Shortage of LFS staff

Staffing levels for the LFS have decreased dramatically over the past six years. Many individuals believe that these reductions had a serious impact on the organization's ability to deliver the forest protection program in 1998—in fact there is a wide-spread belief that this is the most significant reason for the organizations inability to promptly control some wildfires in 1998.

Exhibits VI-1 and VI-2 show the changes in staff levels within the LFS since 1992. The first graph shows changes in salaried personnel and the second graph shows changes in salaried and non-salaried personnel combined.

Exhibit VI-1
Changes in salaried/staffing levels

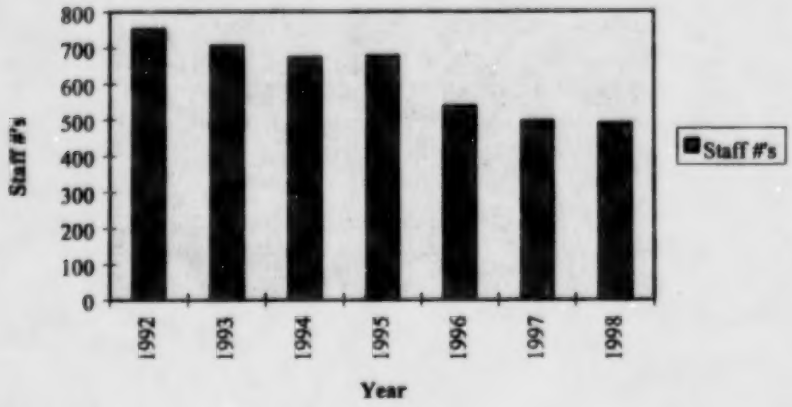
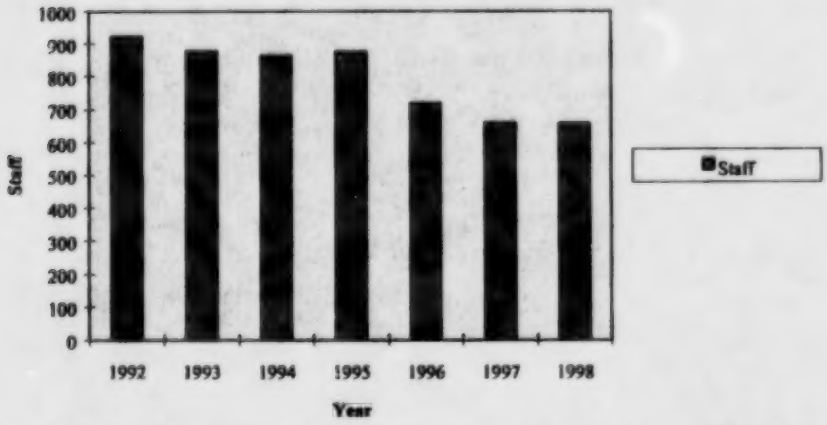


Exhibit VI-2
Changes in total LFS levels (salary & non-salaried)



Since 1992, staffing of salaried people in the LFS has decreased by 35 percent, dropping by 264 people from 751 to 487 permanent positions. In addition, the total staffing level of salaried and non-salaried people decreased by 29%, dropping by 266 people from 921 to 655 people. This staff reduction occurred as part of a broad restructuring of the Department of Environmental Protection and of the LFS itself.

Some of the reduction related to the elimination of certain programs and activities that the LFS traditionally carried out and that are completely unrelated to forest protection. The remaining staff reductions were more general in nature, affecting staffing throughout the organization. The result is that there were fewer forestry personnel throughout the LFS, for the fire control program to draw on during periods of heavy fire load and human resource demand.

Over the staff reduction period of 1992 to 1998, it should be noted that all individuals that left the Land and Forest Service did so voluntarily—there were no lay-offs. In addition, only vacated positions deemed non-critical were abolished and used to meet the down-sizing targets. In terms of the forest protection program, no critical position was abolished and any critical position vacated through attrition or voluntary severance was filled with staff from within the organization.

While fewer forestry staff were available to the Forest Protection Program in 1998, a simple head count does not necessarily indicate the capability of the service with respect to fire control. Another way of looking at the issue is to consider staffing dedicated full time to the program. Exhibit VI-3 and VI-4 shows the staffing levels dedicated full time to the forest protection program in the field and at PFFC in terms of salaried personnel as well as salaried and non-salaried personnel combined. The exhibit shows a decrease in dedicated staff of 22 percent in 1993 and a stabilization at that level through to 1998.

Dedicated staffing has increased in 1999 as a result of changes in organizational structure and resourcing made to address issues arising from the 1998 fire season. The two exhibits suggest a similar reaction to the 1995 fire season—another difficult fire season that occurred during the staff reduction period.

Exhibit VI-3
Staff dedicated to the Forest Protection Program (salaried)

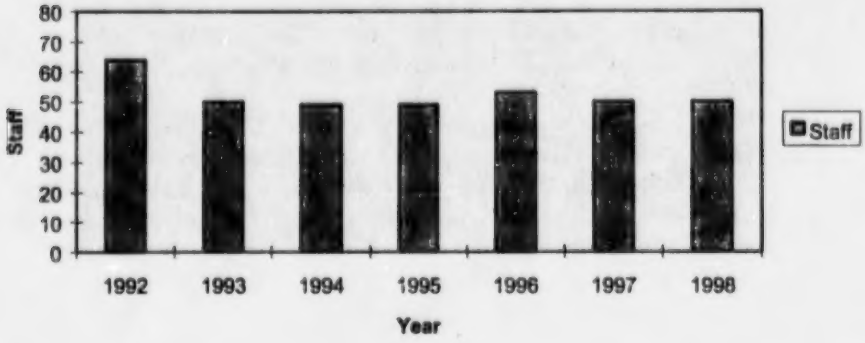
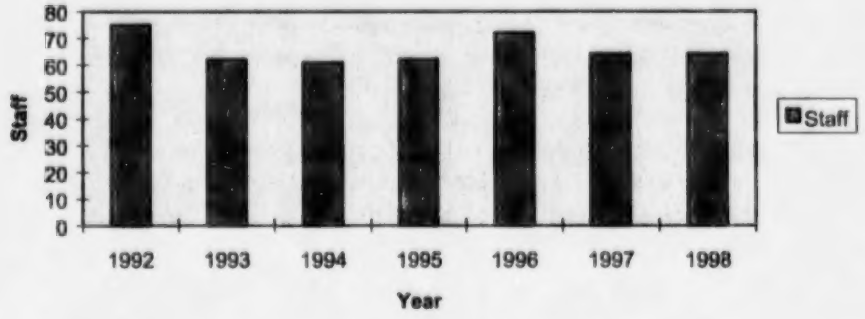


Exhibit VI-4
Staff dedicated to the Forest Protection Program (salary & wage)



Full time dedicated forest protection staff consist of individuals that are highly trained and experienced in forest protection and usually include a number of specialists. These people are largely responsible for establishing and maintaining programs, setting procedures and guidelines, planning, and making resource allocation decisions throughout the province. Clearly a strong staff complement dedicated to the program full time adds to the quality and continuity of the fire program.

In addition to a stable staffing level dedicated to the forest protection program, certified fireline individuals are available to supplement the existing staff through the Mutual Aid Resource Sharing (MARS) agreement in place across Canada.

Shortfalls in human resource availability during periods of high fire activity can be mitigated through the MARS agreement.

If general decreases in LFS staffing significantly affected performance in the 1998 fire season, we would expect to find evidence of the inability to fill overhead or fireline supervisory positions during the fire season. There was no evidence found that would suggest that this was a problem in 1998. Sources of information or evidence included interviews, fire review documentation and FIRES reports regarding resources at the various fires. This partly reflects the ability of the LFS to draw on human resources from the MARS agreement for key positions.

Though there is no evidence suggesting that a general decrease in LFS staff affected the outcome of the 1998 fire season, the discussion does bring to light a related issue—the level of dependency of the LFS on outside resources, particularly the MARS agreement. Concern has been expressed that at two levels, the LFS calls on the MARS agreement too quickly. The first level is the reliance on the MARS agreement for overhead and fireline supervisory positions. The second is the reliance on the MARS agreement for certified fire fighters. A decrease over time in the number of certified firefighters at the level III category represents a loss of Alberta's strategic reserve of firefighters. This issue relates to a number of factors to be assessed in part 2 of the project such as the level of protection appropriate for the province and the sustainability of the MARS agreement and fire control agreements given the level of protection required.

Conclusion

While it is clear that the staffing level of the Land and Forest Service decreased significantly since 1992, staff dedicated to the forest protection program was not reduced to near the same extent. Since the LFS has historically carried out a very broad mandate with respect to overall land and resource management, reductions within the overall organization are too general in nature to correlate to the performance within the Forest Protection Division. There is no evidence to suggest that overall general staff reductions within the LFS had a significant or direct impact on the outcome of the 1998 fire season.

2. Inexperience of staff in key roles

Throughout the process of interviewing LFS field staff and forest industry representatives, the issue of a lack of experienced LFS staff available or assigned to fire duty was brought up with regularity—more so than any other issue or concern, with the exception of the staff reduction issue. This particular issue is more specific

than the first, in that it addresses direct impacts of downsizing on the organization's level of capability regarding forest fire management.

A number of anecdotal accounts were shared describing situations where staff taking on decision-making responsibilities were unprepared or under-qualified for the role. While this type of situation will likely occur to a small extent in any multiple wildfire situation, the perception is that it occurred to a greater than usual or acceptable extent in 1998. The following analysis brings relevant data forward which more completely considers the perception that he LFS suffered in 1998 from a lack of experienced fireline capable staff.

A review of net reductions of staff between 1993 and 1998 indicates that the LFS lost a total of 1,916 person years of overall forestry experience from those personnel that were fireline certified. While there is no data to document the level of experience among all fireline certified individuals in 1992 before reductions were implemented, an optimistic estimate used for this analysis is a total of 7,240 person years of experience. This estimate is based on the following:

- Determining the average levels of forestry experience for each position classification vacated.
- Determining the total number of forest officers and forester positions in place in 1992.
- Applying the position experience level to the position numbers.

It is likely that vacated positions reflected a higher level of average experience (retirements, early retirements, more experienced individuals suited for new career opportunities) than overall average experience levels in 1992—therefore the actual experience level in 1992 would likely have been somewhat lower than the estimate of 7,240 person years.

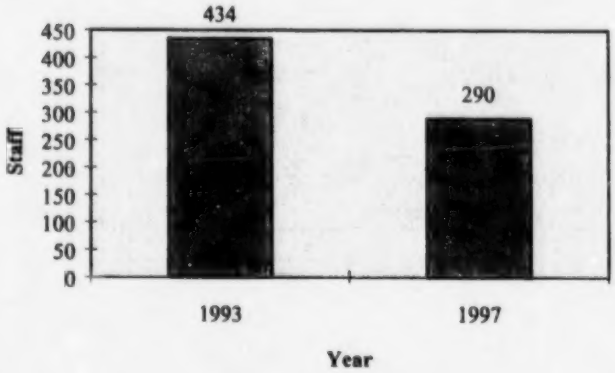
Using this "optimistic" estimate of 7,420 person years of experience in 1992, the LFS lost at least 26 percent of its experience among fireline certified individuals over the 6 year period considered. The estimate of 26 percent is considered to be conservative, given the optimistic estimate of the original experience level within the LFS.

Though experience is only one aspect of an organization's capability, it is one of the most common measures used to evaluate the impact of changes in human resource levels. Given a relatively consistent set of business objectives and delivery

processes, organizations typically strive to manage experience levels to within plus or minus 10 percent of a desired baseline level. Clearly, a decrease of 26 percent or more is beyond typical practice—likely a course of action only followed by organizations convinced that its human resource complement was much greater than required or that its objectives and business process had changed significantly. Neither is the case with LFS.

Exhibit VI-5 illustrates another perspective in evaluating staff experience. Between 1993 and 1997, staff holding some form of fireline certification varied significantly.

Exhibit VI-5
Fire certified staff



The total level of fire certified staff decreased by 33 percent over the 3 year period from 1993 to 1997. As these figures represent the certification status at the end of each given year, the 1997 certification level indicates the capability going into the 1998 fire season. While a complete set of data for years outside of 1993 and 1997 is not readily available, a review of partial data for 1991 and 1992 suggests that the number of certified staff has varied greatly in other years as well. Exhibit VI-6 and VI-7 show certified staff in only command and line positions for the years 1992, 1993 and 1997—the only years with available data.

Exhibit VI-6
Fire certified staff—command and line positions

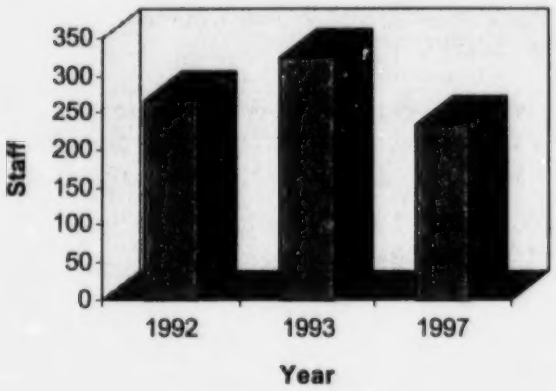


Exhibit VI-7
Selected fireline leadership position certification levels

Position	1992	1993	1997	1999
Fireboss I	18	20	11	12
Fireboss II	56	55	49	84
Fireboss III	50	77	44	n/a
Totals	124	152	104	n/a
Sectorboss	88	105	82	170

Although command and line positions such as fireboss and sectorboss are key to sustained firefighting activities, similar decreases in other important certified fire positions become evident when you examine the data. These other positions, such as Service Chief II positions (37% reduction since 1993) and Plans Chief I positions (55%reduction since 1993) are also critical to the integrated management of the program systems.

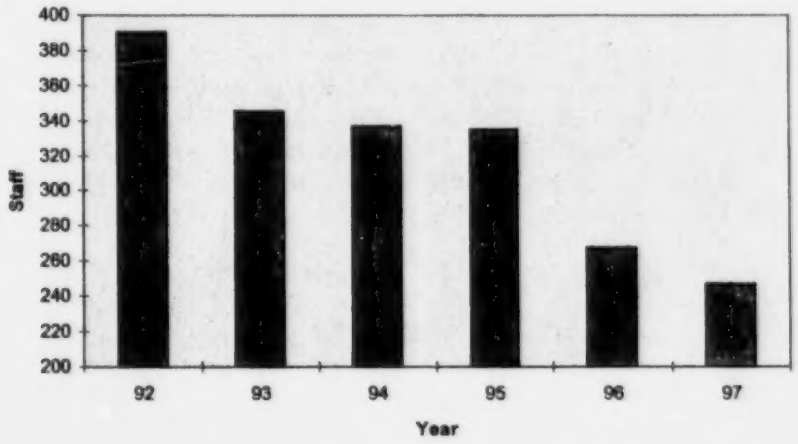
It is evident that the decrease in certified staff positions from 1993 to 1997 have resulted from factors other than simply staff reductions during that period of time. Years of low fire activity have decreased the ability for fireline LFS staff to gain

necessary experience and maintain their certification. In addition, a review of partial data for 1999 indicates much higher certification levels—particularly for the sectorboss position—likely a result of increased opportunities for gaining experience.

Another important aspect of the forest protection program is the depth of the organization's human resource component, as indicated by the number of forestry staff that are available and in a position to carry out certain fire related functions during peak times of need. This perspective complements a review of fire certified individuals in that forest officers and foresters make-up the pool of human resources most prepared to become fire certified.

The delivery of the forest protection program largely depends on the forest officers and foresters within the LFS who are not dedicated full-time to the Forest Protection Program but who are trained and experienced in fireline and support responsibilities. These individuals are critical to filling certain positions in times of high need, and though not part of the full time dedicated program staff, they largely determine the organizational capability when fire situations dictate. This depth is important from the perspective of the organization's ability to replace key certified staff in the near and mid term. Exhibit VI-8 shows the changes in staffing over time in the forest officer and forester series, which represents the organization's depth and indicates the ability for the LFS to recover in the area of certified expertise.

Exhibit VI-8
Staffing in the forest officer & forester series



A fire organization needs to have the ability to adjust staffing depending on the level of activity and must be able to reach beyond the core forest protection ranks to engage trained and certified people to assist. This exhibit indicates that the depth of the organization with respect to forest protection has been eroded. Staffing levels at the forester and forest officer level has decreased 37 percent. This lack of depth may have been the single most important factor affecting organizational capability in the 1998 fire season.

A review of individual fire team briefings, and fire operations assessments indicated that a shortage of experienced staff did affect performance on fire suppression operations in 1998. Out of a sample of fire reviews and assessments, three cited concerns respecting the experience level of line staff, particularly lineboss and sectorboss positions. This lower level of experience on the fireline results in a need for a more cautious approach to deploying crews and actioning fires.

The decrease in experience levels and certified individuals caused the LFS to take a more precautionary role and kept the LFS from aggressively fighting fire. Often during 1998 weather conditions caused unpredictable fire behavior, which meant that staff unfamiliar with such conditions had to err on the side of caution.

Conclusion

During an unprecedented fire season, the LFS had significantly fewer certified and experienced fireline staff than would have been the case in past years to manage the extreme wildfire situation in 1998. The organization lacked the depth to supplement the primary fire organization with forest officers and foresters from elsewhere in the organization. Given the data showing depletions in experience levels, members of certified staff and organizational depth coupled with evidence of concerns about experience levels available on the fireline, it is reasonable to conclude that reduced experience levels in the LFS is an issue that affected performance in the 1998 fire season. While the root cause of the depletion of the human resource capability is not clear, it is likely a combination of two years of inactive fire seasons and general, voluntary staff reductions within the LFS.

Given these human resource constraints, the Land and Forest Service performed admirably. Safety was maintained—no fatalities or serious injuries occurred as a direct result of fire suppression activities. In addition, most staff performed well beyond expectations both in terms of responsibilities assumed as well as hours and numbers of days worked. In the face of adversity, the

organization as a whole clearly demonstrated its commitment to fulfilling its mandate to protect lives, property and public forest resources.

The personal and professional dedication of the LFS staff, however, cannot overcome the depleted level of human resources within the organization. Current human resources may be adequate during average and below average fire seasons, but are clearly inadequate for high fire seasons such as 1998. The shortage of experienced and trained people, the shortage of forest officers and foresters to draw on, and the ensuing exhaustion that is experienced by the people who are called upon to handle the situation is too much of a barrier to effective program delivery.

Recommendations

1. Undertake an immediate investment in people to increase the level of fire certified staff and individuals available for fire duty. This investment should be implemented over the 1999 and 2000 fire seasons by enhancing:

   - Training opportunities for all forest officer and forester staff.
   - Opportunities for all forest officer and forester staff to gain fireline experience.
   - Mentoring relationships between experienced certified fire management specialists and forest officer/ forester staff with an aptitude or potential in fire management operations.
   - Succession planning/management—Identifying individuals with the potential to fill key positions in the future and ensuring that they are given the appropriate training and experience.

   In 1999, the LFS had increased the availability of training opportunities and was making an effort to provide opportunities for all staff to gain fireline experience and obtain higher levels certification.

2. Increase depth with respect to back-up fireline and support positions resources by:

   - Ensuring that all LFS forest officer, forester and selected management staff receive a base level of training with respect to safety, key fire

management procedures and common support functions, to enable them to more readily participate in critical fire situations.

- Actively encouraging companies operating within Alberta's forests to make commitments within their respective fire management plans to maintain training and certification levels appropriate to the size of their operations.

- Actively developing and maintaining a network of out-of-service fire certified individuals for fireline and overhead positions through seasonal contract opportunities and agreements.

3. Incomplete training

Training is a critical component of building and maintaining a competent organization. Training must address the skills required within the protection program, must be made available to the right numbers and types of people, and must be offered at the right time of year to be useful within the fire season. A review of the types of courses offered, the quality of the curriculum and the expertise of the instructors suggests that the training program is of high quality. Some concern has been expressed, however, that training was not complete in 1998 within the time frame required to adequately prepare for the upcoming fire season.

The issue of the completeness of training in the spring of 1998 is primarily related to pre-suppression and preparedness and is dealt with in Chapter VII, along with other preparedness issues. The issue of inadequate training is, however, primarily related to organizational capability. This issue was addressed by interviewing key individuals who deliver training and key individuals who commission or "purchase" training. In addition, the types of courses and training sessions offered were reviewed in the context of training offered in other jurisdictions and the demands of the program and program managers.

An additional issue, somewhat related to training, that also arose during the training issue review was that a mentoring role at the forest area level has been diminished or eliminated. In the past, the Forest Officer III position was largely a mentoring or coaching position for all functions, particularly fire management. This role helped to increase the effectiveness of forest officers by providing on the job training and by helping to bridge the gap between training and real life applications of policy, procedure and techniques.

Conclusion

Overall, the training delivered by the Land and Forest Service and Environmental Training Centre is complete and of a high quality. The type and quality of training offered to LFS staff had no impact on the organization's performance in 1998, other than perhaps to contribute to the excellent safety record experienced during the fire season.

Though training was available to individuals working in the Forest Industry and other industry sectors, there was little training carried outside of the LFS over the years leading up to the 1998 fire season. While the issue of roles, responsibilities and communication involving the LFS, forest industry and other industries is dealt within Chapter IX an increased emphasis on training non-LFS staff may have helped with the coordination of resources and with communications.

Recommendations

3. Develop training to address the increased desire of the LFS, forest industry and other industry participants to work together during critical fire situations. While some training is already available, industry participants, through the Alberta Forest Protection Advisory Committee, should indicate what additional training opportunities are needed. Industry sectors should also commit to maintaining a certain level of training within its operations staff—a level to be determined by each company with input from the LFS.

4. Promote mentoring in forest fire management at the local level as a means of providing on the job training linking formal training and real-life application. A senior forest officer, experienced in fire management operations, should be identified and formally assigned a mentoring role for key fire management staff at the local level.

4. Availability of district staff

During the course of interviews, it appeared that key district staff were not available for fire duty when called upon for a variety of reasons. There were individuals on fire training who were not present at their respective districts but who could be available if needed, and there were those that were not on duty (not on call or on vacation) and not easily called upon in the event of emergency need. Given the fire indices at the time and the presumed knowledge of the dry weather and potential hazardous

risk issues, it would have been prudent to ensure a greater level of staff availability in key areas.

Conclusion

Provincial guidelines are in place for staff availability during certain conditions or when conditions fall within certain parameters. Situations where these guidelines were not followed are isolated and do not reflect the general behaviour of forest area staff within the LFS.

Recommendation

5. Review the guidelines for staff availability during periods of high fire hazard and the degree to which area managers have discretion in adhering to the guidelines. The guidelines should be followed more closely at the forest area level.

5. Acceptance of change

One of the more common comments from LFS and forest industry staff related to the degree to which LFS staff accept the changes that had been occurring over the past 5 to 6 years. Much discussion had ensued during interviews regarding the effect of these changes on morale, commitment to the organization and performance.

It is a generally accepted observation referenced in organizational theory that most individuals resist change and often view new objectives, structure and systems as threats. Those most opposed to change (usually a minority) typically leave to find other opportunities. The majority feel threatened by change to some degree, but eventually adapt as the new organization becomes entrenched. A small group embrace change and help to create the new organization. All of these characteristics were evident through interviews with LFS staff as well as industry staff who witnessed or were involved with the changes.

In assessing the impacts that staff morale or commitment may have had on the delivery of the fire management program, evidence was sought to show that individual or team performance was noticeably below expectations, and that where this was found, that it related to a sense of employee dissatisfaction. No documented cases were found to suggest that any individual's performance was unsatisfactory or below expectations due to dissatisfaction or morale issues.

Conclusion

While a number of individuals within the LFS may continue to have difficulty accepting organizational changes, this important organizational management issue had no direct impact on the outcome of the 1998 fire season.

6. Exhaustion in key positions

Comments were often shared by LFS staff that exhaustion was a significant factor in the 1998 fire season and that exhaustion in key positions affected the outcome of the wildfire situation. The comments included specifics such as long hours, heavy physical and mental demands, and very high performance expectations as contributors to exhaustion, particularly in the August wildfire situation.

If exhaustion were a significant factor affecting performance in the 1998 fire season, we would expect to find evidence of failures by individuals to carry out key functions and responsibilities or reported health problems associated with overtaxing situations. These are very difficult occurrences to identify and relate directly to exhaustion.

A review of records and interview information aimed at symptoms of exhaustion revealed very little. Anecdotal accounts of exhaustion suggests that this was a very real concern among many individuals, however there is little evidence to suggest that exhaustion contributed to the outcome of the 1998 fire season.

Conclusion

Though exhaustion was likely a valid concern with many individuals who worked in various positions over the 1998 fire season, there is no evidence to suggest that exhaustion significantly affected the outcome of the 1998 fire season.

VII

Organizational Preparedness

A. Introduction

The word **"prepare"** is defined as **"to make ready"** by Webster's New Dictionary. It has as its root the Latin word **"preparare"** which is **"to make ready before".**

In a forest fire management context, preparedness involves the deployment of suppression resources based on predicted fire arrivals, weather, fire danger indices and values at risk in advance of fire starts. As fire danger increases additional suppression resources are acquired and strategically deployed to be available for potential new fire starts; i.e. **"to make ready before".**

Preparedness includes the training and equipping of fire crews, enhancing detection, maintaining and positioning resources, and prioritizing and responding to various levels of predicted fire starts. It can be a complex mix of early warning systems, budgets, local risk assessment, weather forecasting, application of fire danger rating indices and the availability of suppression resources. It is not an exact science and the application of current software and local knowledge to a preparedness planning system is essential. As well local fire officers need to apply the PPS with local knowledge and experience and at times take some risk as they balance costs versus risk and values.

The Canadian Fire Glossary defines preparedness as:

> *"Condition or degree of being able and ready to cope with an anticipated fire situation".*

An effective initial attack is dependent on how well the pre-suppression preparedness system (PPS) has been applied and the commitment by the organization to put in place the levels of resource deployment dictated by the outputs of the PPS. One level of success can be measured by examining the success of the initial attack, such as a certain percentage of fires contained within pre-set objectives.

B. Background

It is a costly and time consuming endeavor to suppress wildfire in the boreal forest, and it can be dangerous. Wildfires often occur randomly and create a situation where fire organizations strive to protect human safety, reduce losses to private values and protect valuable commercial fibre. Man caused fires can be extremely difficult to predict especially arson, which further compounds the issue. Values demanding protection now go well beyond the traditional and include watersheds, habitats, recreation potential and biodiversity to name a few.

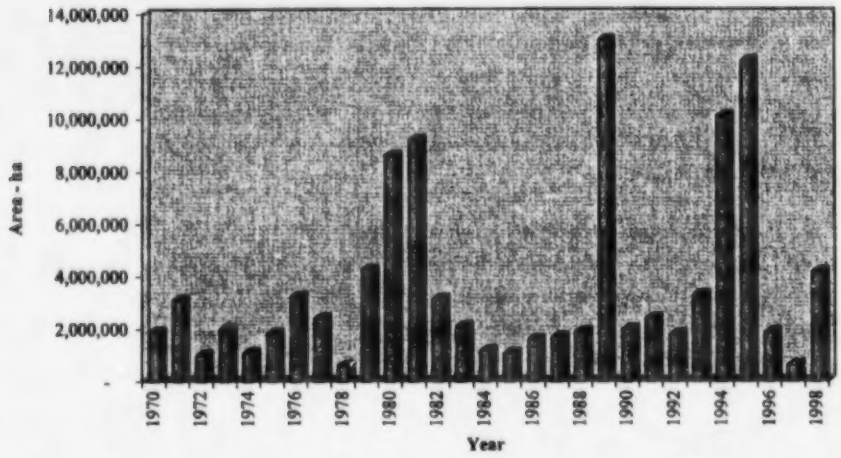
The ability to contain every wildfire at initial attack does not exist even with the most sophisticated of systems and organizations. Fuels, fire weather, multiple starts, topography and access often combine to thwart success. Initial attack objectives can only be addressed by preparing well ahead of time and taking the pro-active steps to resource and to meet the expected demand.

In Alberta as elsewhere in boreal North America, the situation is aggravated by vast expanses of continuous fuels (often over-mature), and often the result of decades of fire exclusion on the landscape by well developed and managed fire suppression organizations. Compounding all of this is a growing population with an increase in people building and living in the rural / urban interface.

The number of Fires and the area burned in Canada have been escalating dramatically during the past three decades. Although there is mounting evidence that the apparent increase in fire activity in Canada may be a result of more accurate reporting—this is only one possible conclusion. There is growing evidence that fire exclusion policies, climate change, global warming (1998 was the warmest on record) and more recent erratic weather phenomena may be having a larger impact.

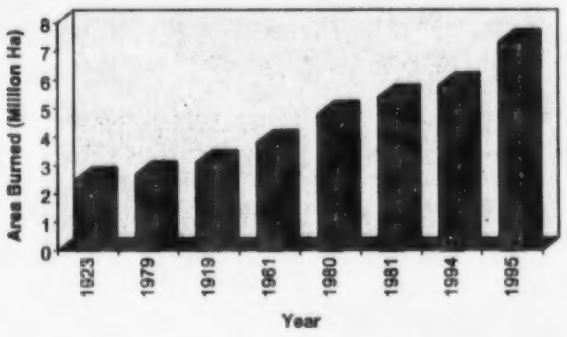
Global fire statistics reveal a similar pattern in Brazil, Florida, Mediterranean Europe, Australia and Southeast Asia. Exhibit VI-1 shows the fire occurrence in Canada since 1970. Four of the worst fire years since records were established occurred in the last 10 years. Exhibit IV-2 shows the 10 worst fire years in Canada since 1919.

Exhibit VII-1
Forest fires in Canada 1970 - 1998



Source: Canadian Forestry Service.

Exhibit VII-2
Worst fire seasons in Canada



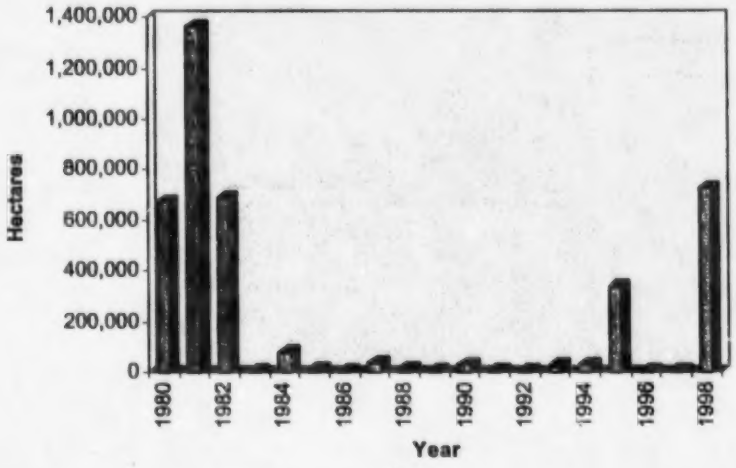
Since 1983 an advanced pre-suppression preparedness (PPS) system has been developed and used in Alberta. The objective of the system has been to minimize the potential for

large fire losses through improved initial attack strategy, including spending pre-approved allocations on man-up. Investment is made prior to severe situations in order to reduce the cost and impact of large fires.

The PPS manual describes the system in general terms "as the fire danger increases, additional suppression resources are committed and strategically placed to reduce travel time to a potential fire start. As the fire danger decreases, suppression resource levels are reduced and travel times relaxed in recognition of the lower potential for fire control problems."

The system has had significant results, and for 16 years, with the exception of 1995 and 1998, has yielded the desired objectives. The Alberta PPS has been used as a standard for other Canadian fire agencies and the results often quoted by managers and fire specialists as being exemplary. The outcomes of the PPS system are to some extent reflected in Alberta fire history data presented in Exhibit VII-3. This is included to show what appears to be the immediate impact of the introduction of the PPS system.

Exhibit VII-3
Preparedness system results—Province of Alberta



Source: Alberta Forest Service

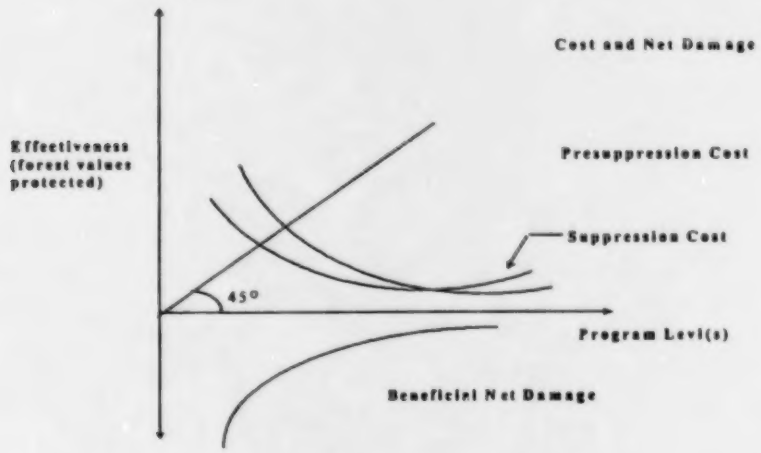
Over the intervening years, more sophisticated information management and software programs have been developed and implemented. This has allowed more parameters to be

examined and analyzed and a more accurate output for both provincial and local fire managers to use in preparing for predicted fire loads.

Alberta now has a well-developed PPS and it is used to guide the man-up procedures to meet expected fire arrivals. However, in 1998 a number of fires did escape initial attack and the resulting large area burn data is reflected in the figure. A key question is what role did preparedness contribute to the successes and failures of initial attack in 1998.

The PPS measures taken must be commensurate with the expected fire starts, fuel, weather and the values at risk. The bottom line is that the more you spend on preparedness (effort) the more significant these expenditures will be on reducing area burned and suppression costs. The question becomes one of balancing risk with the values and expenditures. This balance is illustrated in Exhibit VII-4.

Exhibit VII-4
Results chart



Source: Alternate expressions for the Economic Theory of Forest Management, D.B. Rideout & P.N. Omi

There are two levels of preparedness: short and long-term. In Part 1 of this review, only the short-term measures (actions taken or omitted to meet expected fire loads) will be examined.

The longer term preparedness measures including values at risk, integrated fire management policies, landscape planning investment in fire infrastructure, funding options, inventory levels (Alberta and Canada) will be examined in Phase 2 of this review.

C. Issue analysis

A recurring theme expressed in the interviews with the forest industry, other stakeholders and by some LFS personnel, was that preparedness measures in some regions were not adequate for what was experienced in the Spring of 1998 and throughout the fire season.

An example of comments heard include:

- *"Preparedness—LFS was not prepared in May of 1998. Fuel and weather conditions must be assessed and appropriate resources put in place".*
- *"There is currently no formal process in place involving the forest industry to be involved in priority setting".*
- *"Preparedness in 1998; it didn't work. Towers were not fully operational. Start-up indices were not reflective of the actual DC's. Training courses were not accelerated".*

While these comments reflect experience and perspectives at a local level, the thrust of the preparedness analysis is how the program or system operated at a provincial level. This helps us to understand whether there are systematic issues or program implementation issues to deal with. Following are some of the key questions or issues analysed that relate to preparedness in late April and early May 1998.

- Were start-up indices inaccurate in some locations, thus affecting the preparedness plan outputs? Were over-winter drought and early Spring conditions not adequately inputted to planning for the 1998 fire season?
- Was the training program incomplete in the spring of 1998?
- Air Tanker readiness and availability--were rotary wing contracts in place for early May fire-load?
- Were some key towers not manned prior to May 2, 1998?

- Were PPS system deliverables not in place? Were man-up, air-tankers and helicopter resources less than the plan would have indicted?

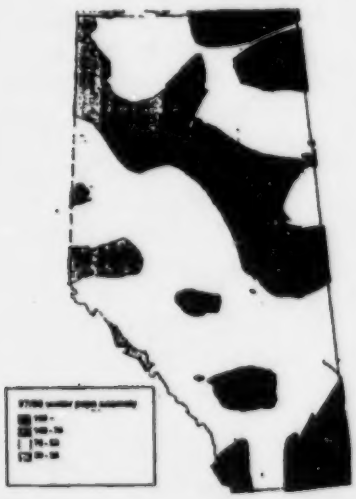
- Were key resources committed outside of the protection area, when needed inside the protection area?

These questions are addressed in the following sections.

The over-winter drought in most of Alberta really began in November 1997 with most areas of central Alberta snow free until January 1998. Significant grass and brush fires occurred December 13 and 14; one fire south-west of Hinton and one fire near Granum. Although not without precedent, these fires were an indication of erratic weather and developing drought. Over-winter precipitation was well below normal throughout Alberta and no significant rainfall occurred during the last three weeks of April.

The risk of spring fires (April - early May) is most enhanced by low over-winter snowfall and dry conditions in the Spring. Virtually no precipitation was received in the green areas during the last three weeks of April 1998.

Exhibit VII-5
1997/98 over winter precipitation anomaly



There was considerable concern expressed by seasoned fire staff, that in the key fire start areas in early May, the fire danger rating system indices did not reflect the observed burning conditions. In particular, field staff in some forest areas believe that the drought codes and build-up index were lower than what was observed with actual fire behavior.

As well, although the fall and over-winter ('97 - '98) snow pack, and precipitation were well known (and documented), there is no evidence that this data was widely discussed within LFS or with the key forest sector and other protection partners. Some districts and forest companies did take positive preparedness actions while others seemed to follow a normal spring routine leading to the fire season start.

In contrast to the anecdotal evidence from some field staff, the Provincial Forest Fire Centre (PFFC) has conducted a detailed assessment of over winter precipitation and its impact on drought codes and fire weather indices in general. The conclusion reached is that starting drought codes accurately reflected actual conditions and that other indices more directly related to fire behaviour, such as build-up index, were also accurately reflected. Concern was expressed in the LFS review that the initial comments reflected a poor level of understanding of fire weather indices and predicted fire behavior

Conclusion

Though fire indices were accurate for the early spring period, insufficient attention was given to the significant over-winter weather and drought events in some forest areas and this had a negative impact on some forest area's ability to meet the fire arrival demands in late April and early May. The main issue appears to be the fact that field staff do not fully understand fire danger rating indices which led to a less than adequate response to the actual conditions.

Recommendations

6. Monitor over-winter weather and fuel conditions monthly. Provide formal briefings and data to the LFS executive and Provincial Fire Centre . Preparedness planning in March and early April must reflect this data.

7. Train all Land and Forest Service staff that are involved in the fire management program on the Canadian Forest Fire Danger Rating system and its applicability to fire behavior. Training programs would last approximately one half day and should be offered in the winter of 1999/2000.

D. Incomplete training

A recurring theme with the LFS partners and forest sector was that fire training was incomplete or suspended at the start of the fire activity in late April and early May.

> *"Conditions were recognized early in the Spring. Level 1 crews were brought on early, however not all training was complete".*

The Environmental Training Centre at Hinton works with the LFS to plan and arrange delivery of the Wildland Fire Management Training in Alberta fire. Most training courses developed are planned and implemented by LFS staff. A review of their '98 Departmental Courses and the course delivery and attendance summary, provided an overview of training program deliverables. The data has been summarized in Exhibit VII-6.

Exhibit VII-6
1998 fire training summary

Course category	Planned	Held	# trained
Fire line-suppression	52	45	1,462
Fire line management	4	4	30
Air operations	3	2	10
Data management	23	18	127
Duty officer/dispatcher	2	2	12
Lookouts	1	1	16
Totals	85	72	1,657

For purposes of this summary the courses were grouped by six broad categories and they do not include the training directed at fitness certification, safety or chain saw operations. It is apparent from the summary that a large number of staff received training (1657) and in spite of the early fire arrivals at the end of April, only 15 % of the planned courses were not held.

A concerted effort was made to ensure the fire line personnel were trained or re-certified prior to placement on fires. Training was undertaken at fire base camps during fire

operations, and many of the courses were rescheduled and completed during periods of low fire activity.

The training plan for 1998 and again in 1999 has some courses scheduled for fire line personnel (both WFU's and management) in late April and continuing through May. Given the early start to fire activity in '98 and again in '99 this resulted in fewer trained staff available early in the fire season, therefore having to assign personnel with less than the optimum level of training to fire duty. Even though the fire season in early spring typically occurs regionally, and courses can be scheduled to correspond with hiring, the majority of fire line suppression and leadership courses should be completed prior to the end of April.

Student crews make-up a small but important part of the initial attack capability and are viewed as very competent fire crew members. They are not available until the school term is completed—typically early May—and therefore were not available for early spring fires as occurred in 1998. Given the variety of colleges and universities involved, it is not feasible to suggest a semester change to accommodate the LFS for a few individuals.

The fire training environment is changing in Alberta with new technology (i.e. self-directed CDRoms) and with alternative venues now available, such as the Alberta Vocational College. This allows the LFS to access personnel from a variety of training options.

In addition to the perceived training issue, concerns about new fitness standards were discussed by many of the forest industry participants. The concern is that new standards will deny some of the seasoned forest industry staff from being assigned to fire operations work. These changes are now in place and heavy equipment operators and CAT bosses are not subject to the same rigid fitness requirements. This has been a major improvement in allowing these skilled forestry personnel to be assigned to fire duty.

The Forest Industry Certification and Training Task group has addressed these issues and delivered a report and set of recommendations. The implementation of this report will significantly enhance the application of industry staff to fire operations and allow the industry to provide quality staff assistance to the LFS during periods of active fire operations.

Conclusion

In spite of an exceptionally early start to the 1998 season and the severity of the season, the majority of the wildland fire training program was delivered and trained personnel assigned to duty. Rescheduling of suspended courses and an accelerated program for 1999 has ensured an adequate level of certified staffing. The suspended or delayed courses 1998 had little impact on being

able to staff the large campaign fires and still maintain adequate initial attack strength.

The use of forest industry staff in many fire line and support positions was constrained by the application of certain training/certification and fitness standards. This resulted in inadequate manning of some fires on industry FMA's and frustrations between LFS and industry staff in 1998. These frustrations were evident immediately following initial attack failure as many industry staff were used during sustained action. It should be noted that training was offered to industry participants in the early spring of 1998, however no industry representatives were in a position to take advantage of this opportunity.

Of special note is the role and performance of the Environmental Training School and LFS training unit in Hinton. The school has long been in the forefront of training and development of fire managers and firefighters in Alberta. In addition, the development of cooperative processes with many other Provincial and Federal jurisdictions has placed the training school at the forefront of training and development throughout the nation.

Despite some recent downsizing and re-organization initiatives, the Hinton Environmental Training Centre and LFS has delivered its training program effectively. This was accomplished despite unprecedented demands. The LFS and stakeholder group needs to recognize the invaluable contribution of the school to the Alberta protection program. A recent and equally important aspect of the school is it's influence on all fire management personnel, since nearly all program personnel transit through the school yearly for various reasons. If the staff of the school are always fully informed as part of program development initiatives, important information is transmitted to all.

Recommendations

8. Schedule completion of all fire line courses before April 15 each year. The only exception to this is training for student crew members.

9. Review the current availability of trained, certified fire fighting personnel by level and identify gaps created by the 1998 fire season and any adjustments to the field fire organization. Target staffing availability need to be created for each level in the fire management organization and a long range plan to deliver the appropriate number of certified fire trained personnel must be developed.

10. The recommendations of the Forest Industry Certification and Training Task Group should be implemented with the forest industry across Alberta:

    - Develop a one or two day fire safety seminar for woodlands personnel, logging contractors, and road building contractors including cat contractors.

    - Track the safety orientation for each employee on the LFS FIRES system to ensure compliance.

    - Deliver the "dozer boss" course at field locations that would involve all sectors.

    - Deliver the "dozer boss" course using LFS certified training contractors or a combination of LFS staff, training contractors and forest industry personnel.

    - Involve company employees and contractors in raising an awareness of the fitness standard for dozer bosses and develop a program to help interested individuals to achieve that standard.

    - Improve the level of standardization of certification for industry staff and LFS staff, as well as for out of province resources.

E. Air tanker/rotary wing availability

Throughout the interviews and focus groups held across the province, a number of concerns were expressed about airtanker and rotary wing aircraft availability.

"Air tanker groups were not available during the critical times".

The following is a summary of the air tanker gear-up taken from the daily situation reports for the critical period April 28 through May 3. As well, Exhibit VII-7 lays out aircraft availability during the same period.

- April 28: 10 new fires, 13 burning, five not under control. The first air tanker group was brought on early; it was originally scheduled for May 2.

- April 29: 11 new fires—15 burning—six not under control. Two more air-tankers were brought in early.

- April 30: nine new fires—two not under control.
- May 1: 12 new fires—one not under control.
- May 2: 11 new fires—two not under control. Two more tanker groups brought on early.
- May 3: 20 new fires—nine not under control with some taking major runs. One more air-tanker group was added for a total of six at this time.

Exhibit VII-7
Tanker group availability[1]

Date	Bird dog 1 DC 6	Bird dog 2-215	1-215	Bird dog 3-26	Charter 1 BD, 3-26	Total air tankers	Total tanker groups
April 28				1		3	1
April 29	1	1		1		6	3
April 30	1	1		1		6	3
May 1	1	1	1	1		7	3.5
May 2	2	1	1	1	1	11	5.5
May 3	2	2		1	1	12	6

By April 28 the early fire arrivals were occurring and the situation was escalating through May 3 when the wind event resulted in 9 fires escaping control. The air tanker groups were not scheduled to be on station until May 2; this was moved forward, with a build up of air tanker groups to 6 taking place April 28-May 3. Given the indices, forecast weather, new fire arrivals and escaped fires, these air tankers numbers were not sufficient to cope with new initial attack and continued sustained attack.

It is not a simple task to accelerate the start-up dates for air operations on short notice. Training has to be completed, check flights undertaken and other Transport Canada regulations satisfied before aircraft can be placed on active duty. The fact that six airtankers were brought to operational status in a five day period is a very significant

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[1] *One single 215 available (1/2 Group) on May 1. It was combined with another on May 3 to make a complete tanker group.*

accomplishment. In addition, a number of lakes were still partly frozen over which precluded the use of CL215 airtankers at those locations.

Exhibit VI-8 shows the availability of rotary wing aircraft for the same period. Although the data may be incomplete in the total picture - of the medium lift helicopters scheduled for long term charter only 4 were actually on station prior to April 28. It does appear that a concerted effort was made to increase the medium availability as the situation escalated and by May, 3 six of the eight long-term charters were available. The team did not have data on the long-term contracts for the smaller machines, thus only the actual numbers of lights and Intermediates are presented.

Exhibit VII-8
Rotary wing availability

	L	Int	Med	Totals
Prior to April 28	1	0	4	5
April 28	1	1	3	5
April 29	1	3	4	8
April 30	3	1	5	9
May 1	2	2	6	10
May 2	6	4	6	16
May 3	10	5	6	21

Note that the data came from two sources for this table. Light and Medium Helicopter numbers from the PPS Resource Deployment District Summary Reports and from the Aircraft Long-term Contract Summary Report. The PPS Resource Deployment summary did not reflect the long-term medium RW contracts start dates. If anything, the numbers are probably low for May 2 and May 3 as additional RW resources were being added to the escaped fires.

Conclusions

Given the weather and new fires in late April and the current and forecasted fire danger indices there were insufficient air tanker groups or rotary wing resources to adequately address the initial attack and sustained attack operations. Data was not available to compare the PPS plan with the resources made available—this reflects a problem that the LFS is experiencing with its information system (FIRES).

A concerted effort was made to provide additional aerial resources, however these were not readily available from adjacent fire agencies due to the early start of the fire season and contracts and training incomplete in the respective jurisdictions.

Recommendations

11. Develop rotary wing and air tanker contract terms that will allow for start up dates that reflect over winter precipitation and anticipated spring fire hazard indices.

F. Towers not manned

Alberta uses a detection system of towers, aerial patrols and public reporting. The Business plan dictates a target for detection of all fires discovered at 0.1 ha or smaller. Detection is a critical part of the overall fire management program and concerns were expressed by LFS and industry staff that towers should have been manned earlier in the season in key locations.

In examining the records for 1998 there were 45 towers manned on or before April 25, 1998. Another 13 towers were manned between April 28 to May 1 leading up to the major fire arrivals. This resulted in a total of 58 out of 133 towers manned to deal with the early spring fire season. LFS staff have confirmed that all of the Forest Fringe and white area towers were manned and that they had advanced opening dates to reflect the over-winter drought and anticipated early hazard.

Data received during interviews and confirmed by the statistics available does indicate that the towers in the Virginia Hills Fire area were not manned until May 12—10 days after the start of the fire activity in that area. This of course does **not** mean that the detection objectives were not achieved in this case as these fires were discovered almost at ignition by an aerial patrol that was tasked to follow the lightning passage in the area. Staff did confirm that some years ago the white area towers were manned usually by mid-April each year and now the current practice is to man these towers by mid May.

Exhibit VII-9 shows the effectiveness of various detection agents and the importance of lookouts to Alberta's Forest Protection program.

Exhibit VII-9
Five-year detection data

Detection agent					Cause		
Year	Lookout	Air	Ground	Unplanned	Man Caused	Lightning	Totals
1994	411	95	7	359	373	499	872
1995	385	82	5	332	446	358	804
1996	199	42	3	132	159	217	376
1997	243	46	8	159	214	242	456
1998	747	409	13	528	506	1,191	1,697
5 year average	397	135	7	302	340	501	841

Source: Land and Forest Service.

Over the 5-year period the Lookouts discovered an average of 49% of all fires. In 1998 detection by Lookouts fell to a 5-year low of 44 %. Air patrols on the other hand more than doubled the number of fires detected during the same period to 24% from an average of approximately 10.5%. This largely reflects the increased use of air patrols in lieu of towers during the late April/mid May period.

More important than these detection statistics is an analysis of the success in meeting the detection objective of finding all fires at 0.1 ha or smaller. Exhibit VII-10 provides a summary of the detection objective attainment.

Exhibit VII-10
Detection objectives not met (0.1 ha or smaller)

Year	Lookouts	Air	Ground	Unplanned	Average
1994	17%	27%	29%	37%	22%
1995	17%	21%	60%	30%	23%
1996	19%	12%	0	23%	19%
1997	26%	39%	37%	34%	30%
1998	65%	33%	8%	37%	38%

Source: Land and Forest Service.

Of significance is that the data shows that in 1998, the lookouts failed to meet the detection size objective for 65% of the fires they located—this is in the order of a three fold increase from the three previous years.

One can attribute these statistics to a number of factors. First, it has been suggested that the data captured is not accurate for 1998 and changes in the way that data is recorded

does not reflect the true performance of towers in 1998 compared to the years between 1994 and 1997. Perhaps not enough towers were operated in the critical early spring period, or when fires were discovered they were beyond 0.1 ha due to the extreme fuel and weather conditions. Another possibility is that towers were discovering fires at greater distances in other unmanned towers locations—fires would have to be detected at this great distance. An obvious reason once the fires were active was that visibility was often reduced in smoke. Without a detailed detection review, the exact meaning of these figures can not be discerned.

Given the weather and extraordinary early start to the fire season a case can be made for some additional towers to have been manned in the critical regions.

Another recurring theme encountered by the interview team was that most of the tower people now manning the system are from other parts of the province or from other areas of Canada. This has a two fold impact in that it makes flexible manning of towers more difficult, particularly in a pre season fire situation, and new "non-local" tower staff are unfamiliar with the seen area and landscape details at the start of the season. An improved call in protocol for tower people early in the spring could have allowed manning to be moved forward.

Conclusion

The detection success by the lookouts in 1998 fell to a 5 year low of 44%, and more significantly, the detection tower objective was not met for 65% of the fires they reported. Increased air patrols were effective and the delayed tower manning in the critical areas did not negatively impact the final results. There is a need to examine in detail the entire detection system—it's infrastructure, operations productivity, objectives and cost effectiveness to ensure it continues to meet the needs of the fire management system in place within the LFS.

Recommendations

12. Audit the method of capturing tower performance data used in 1998. The goal is to confirm or revise the KPMG analysis that indicates a significant decrease in tower performance.

13. Examine and adjust the criteria for selecting start up dates for towers based on over winter precipitation and anticipated spring indices.

14. Establish a phone in protocol for tower people to facilitate flexible start ups and to support Recommendation 13.

15. Initiate a recruitment and training program to staff more of the lookouts with local people to help facilitate flexible early manning.

G. PPS deliverables not in place

As indicated previously, preparedness refers to the *efforts "to make ready before"*. In the context of the LFS approach it is the planning that determines the resource levels required to meet or at least cope with an anticipated fire situation. The LFS has had in place since 1983 a preparedness system that has served it well. Exhibit VI-3 summarizes these results.

In 1992 the LFS converted to the Integrated Fire Management Information System (IFMIS) to calculate potential fire behavior and the use of these computer software systems aids in determining where the critical resources should be located. Each day the Districts run the IFMIS and reviews the results with the region. With the input and approval of the Provincial Forest Fire Centre, the plan is actioned and resources deployed. There is a policy to deploy double the resources when in any area a Head Fire Intensity of 4000 or higher is predicted. Data to determine (on a sample basis) whether the resource deployments reflected the actual outputs from the Provincial Preparedness System are not reliable. There is a need to improve the FIRES system of capturing and reporting data for the purposes of evaluating the effectiveness of the PPS system.

H. Resources committed outside of the protection area

The legislation, the Forest and Prairie Protection (FPP) Act and Municipal Government (MG) Act, is clear regarding the responsibility for fires beyond the Forest Protection Area. It is the Municipal District/Counties responsibility to manage these fires. As well, it is also clear that it is the private landowners responsibility to fight fires on their own land.

The legislated mandate is reflected in the Forest Protection Division policy statement no. FPD 6.0, dated March 12, 1998 as:

"The Land and Forest Service is responsible for forest protection on all vacant Crown lands within the Forest Protection Area in the province of Alberta. Legislated responsibility for control and suppression of wildfires outside the Forest Protection Area lies with the county or municipality. The province may reimburse the county or municipality for wildfire suppression costs outside the Forest Protection Area in the province of Alberta."

The procedures and guidelines that have been developed to interpret and apply this policy are complete and the assignment of responsibilities and costing well defined. In spite of this assignment of responsibilities, there still exists some confusion and many Municipal Districts and Counties are of the opinion that Land and Forest Service is the forest fire agency for the whole province including areas beyond the Forest Protection Area (FPA). The LFS does have an interest when these fires threaten values within its jurisdiction, and is certainly willing to assist in emergency situations when called upon. In fact LFS has the authority to intercede where a fire threatens values within the FPA.

In 1998, the LFS did in fact commit substantial numbers of resources outside the Protection Area, within 16 km of the FPA. For the critical months of April/May, Exhibit VII-11 summarizes this commitment.

Exhibit VII-11
Resource commitment outside FPA—April and May 1998

		Total resources		
April / May	# fires	Staff	Rotary wing	Air tanker
MD's	11	55	4	1
Railway	2	20	2	-
Town	2	10	-	-
County	3	36	1	-
Indian res.	1	1	1	-
Provincial border zone	5	19	4	1
Totals	24	141	12	2

Clearly the application of the policy, procedures and guidelines reflecting the current legislation is not effective. Apart from the additional costs borne by the LFS (some of which is not collectable), the LFS found itself committed to resourcing county and M.D. fires during a period of time in 1998 when all of its attention and resources were needed within the FPA.

The commitment to these 24 fires was significant particularly during a period when the LFS were fully engaged with active fires within the Forest Protection Area. This diversion of primary forest suppression resources to areas beyond the FPA continued throughout the fire season. Exhibit VII-12 summarizes this commitment to the end of September 1998.

Exhibit VII-12
Resources committed outside protection area—to end of September 1998

Jurisdiction	# fires	Total resources		
		Staff	Rotary wing	Air tanker
Municipal districts	17	89	8	2
Railway	8	110	9	1
Town	2	10	-	-
County	3	36	1	-
Indian reserve	2	1	1	-
Provincial border zone	15	158	9	6
Totals	47	451	28	8

A task force was established with the Alberta Association of Municipal District and Counties (AAMDC and LFS) and appropriate terms of reference were developed to address the concerns. Much good work has been accomplished including a standard template, which can be used as the basis for developing new agreements with Municipal Districts (M.D.s) and Counties. This template could form a provincially acceptable mutual aid agreement. An LFS-industry liaison position has been created and can be used in part to continue the work and provide the MD's and Counties with a direct link with the LFS as these new agreements are developed. This is a positive initiative.

The larger issue remains one of funding forest fire management within these existing County and Municipal Structures. The funding will have to reflect the need for training, resident expertise and the acquisition of sufficient wildfire suppression equipment. The local taxing capability will in most cases be insufficient to ensure adequate protection of the forested areas within these municipalities.

Conclusion

The commitment of suppression resources outside the protection area in 1998 was significant with action on 47 individual fires involving 451 LFS staff and specialized equipment. This allocation impacted on the LFS's ability to meet the demands of the fire starts and sustained action in the Forest Protection Area. The municipal districts and counties have until now assumed that they could rely on the LFS to provide the fire response for their areas. Most of these jurisdictions do not have the funding or expertise to manage these fires.

A solution to this issue is needed and ways to assist the jurisdictions outside the FPA must be developed through revised agreements, extension and brokerage. The AAMDC and LFS Task Force Group has begun this work and

their recommendations will address the issue for the longer term. The LFS-industry liaison contract position can also work with the MD's and Counties and this is a good first step for the 1999 Fire Season.

For the longer term, a new partnership needs to evolve with the government of Alberta that recognizes the funding implications of providing for adequate public safety and protection of private values from wildfires. The LFS can play a significant role in this new partnership with revised agreements and extension work that will allow the Counties and Municipalities to fully assume their legislated mandate for protection.

Recommendations

16. Implement the AAMDC/LFS, provincially accepted, mutual aid agreement template for MD's and Counties. This agreement more clearly lays out the roles, responsibilities and cost sharing arrangements for forest protection activities.

17. Create a provincial contract or salary position, for liaison with municipal districts on forest protection.

VIII

Strategies And Tactics

A. Introduction and background

Strategies and tactics can be described as the art of handling or managing resources committed to forest fire operations. Strategies are those policies and guidelines that are usually directed at the longer term aspects of a program and have an influence on the overall fire management organization's ability to meet their protection mandate. Tactics, on the other hand, are those more immediate actions that are directed at day to day activities and on fire suppression operations.

Throughout interviews with LFS staff and their key partners and clients, a number of issues and concerns were put forward that have been grouped for discussion here as Tactics and Strategies. The development of appropriate strategies and tactics, as applied in a fire management context, is an "art". They evolve over many years by using adaptive management and common sense, within the general policy framework, to arrive at fire tactics and strategies that are appropriate. They work within the given set of physical and organizational frameworks that are in place within the fire agency.

Adjustments to tactics and strategies, given changing organizations and technologies, can often yield significant positive results.

B. Issue analysis

The following topics were raised by individuals interviewed or were identified in other ways by the review team as issues that may have affected the fire suppression outputs during the 1998 fire season:

1. Transition to sustained action on fires that escape initial attack.

2. Night fire fighting operations.

3. Large (Central) catered fire camps and fire line work.

4. Use of heavy equipment.

5. Use of burn-outs.

Many of these issues have been addressed in previous Review Reports and Task Forces including the "Strategy and Tactics Organization Task Force 1985" and the British Columbia Forest Service "Review of the 1995 Alberta Forest Fire Season". As well, all of these issues are being addressed either in the LFS Fire Task Groups or the Improvement Initiatives that are currently underway. A thorough analysis of the ongoing work in these areas was not undertaken . Once the final recommendations and actions of the task groups are known, further comment or recommendations may be developed as appropriate in the final report of this review.

The issue of infrared mapping and scanning was reviewed and there appeared to be no issue or concern. This is an area that could, perhaps, be enhanced in the future as accurate mapping becomes more important in landscape management.

1. Transition to sustained action on fires which escape initial attack

On the surface this was one of the most serious criticisms presented by the forest industry representatives during interviews and discussions. Historically the transition from initial attack to sustained action was very structured. In 1998, the transition was not nearly as well organized and there was a lag in resourcing. Subsequent time delays resulted in compromising aggressive continuous fire suppression action. Examples cited include delays in deploying available bulldozers, establishment of large base camps prior to actioning fires and lack of suppression crews and equipment. Of particular note were delays associated with the lack of radio communications equipment and the arrival of the overhead teams.

On more than one occasion in 1998 obvious delays to initiating aggressive sustained action occurred. The LFS does have in place the procedures to ensure aggressive follow-up to initial attack failure. Normally the Forest Area or District has the escaped fire assessed by a fire Boss II and the District continues to action the fire and add the necessary resources. A review of chronological events of a number of fires showed that delays in adding resources was an important issue in the spring of 1998.

The 1985 Strategy and Tactics Report put forward the following:

"Develop and adopt a formalized standard and systematic operational approach to rapid resource buildup on fires which escape initial attack with the objective of containment in the 1st burning period". It was their conclusion that specialized tactics are needed for larger fires, and, that too often LFS goes from Initial Attack failure to campaign fire mode without looking at the success potential of the intervening 1st burning period."

A lot has been accomplished since that report and aggressive follow-up is now standard on priority escaped fires. However, these standards need to be re-examined and formalized in policy including the option of using burnouts in the first burning period.

Conclusion

The normally effective transition from initial attack to sustained action was strained in 1998, as excessive lags were experienced in the period of time it took to resource sustained action efforts. This difficulty is the result of a number of factors including:

- The large number of fires experienced over a short time in the spring of 1998.
- The shortage of experienced LFS staff to manage the transition process for such a large number of fires.
- The time period it took to bring in resources from other jurisdictions through the Mutual Aid Resource Sharing Agreement was understandably too long to help manage the large number of sustained action efforts required.

In 1999, the LFS changed its organizational structure and approach to managing the transition from initial attack to sustained action. On-going monitoring is important to evaluate any improvements made in this regard or any deficiencies that may worsen the issue.

Recommendation

- Closely monitor the effectiveness of the transition from initial attack to sustained action under the new organizational structure in 1999 to evaluate any improvements made in this regard or any

deficiencies that may worsen the issue. This recommendation is further dealt with in Part II.

2. Night fire fighting

Fighting fire at night (during darkness) in the boreal forest is possible, but without explicit guidelines safety can be compromised and individuals put at risk. It is an issue that continues to challenge fire managers across boreal North America. There is general agreement that night conditions are typically more favorable for crews to work directly on the fire edge and can provide a window to strengthen established firelines. Night fire fighting tactics can often contain fire growth prior to temperature, winds and humidity combining in daylight hours to make such close work improbable.

Again this issue arises from both LFS and the forest industry. The LFS policy is to put in a full day on the fire providing all safety factors are in place. LFS crews do work at night, particularly cat crews, however the concerns about injury, escape routes and lack of rotary wing observation and support have resulted in very little application of the policy other than for fires guard construction.

The 1985 Report recommended that "night fire fighting operations be expanded in the boreal regions" and they put forward a series of implementation guidelines. As well, the 1998 Line Task Group addressed this concern and has developed a number of recommendations to allow greater use of night operations. These include testing a number of crew shifting options in northern areas in 1999 and developing specific guidelines for cat operations, communications, safety clothing and double crewed evacuation helicopters. These measures should ensure a sound basis for enhanced night fire fighting; however, a solid policy commitment on the part of LFS senior management is required as well as acceptance by the field fire staff to make it happen.

Conclusion

Night fire fighting operations have a limited role in fire management strategy in Alberta. Though night fire fighting operations could be increased, this was not an issue that impacted performance in the 1998 wildfire season. The more important initiative is to ensure that fire fighters are on the fireline early in the morning (i.e. first light) to take advantage of the cooler temperatures and higher relative humidities prior to the peak burning period.

Recommendation

18. Continue to pursue the Line Task Force recommendation—"To test fire fighting shifts such as 0500hrs to 1700hrs and 1000hrs to 2200hrs in the northern areas of the province".

3. Large catered fire base camps

The LFS started contracting out large fire base camps in 1998. The rationale for proceeding in this direction is self-evident. With a restructured LFS there are no longer available the necessary number of experienced support people to manage the traditional large fire base camps. As well, in 1998 the myriad of occupational Health and Safety regulations and human resource policy requirements for housing, food preparation and showering etc. dictate a very rigid approach to providing sufficient accommodation for field fire crews. These standards, of course, can be provided by specialized contractors.

There are two schools of thought on their utility; one that says they were successful and a more prevalent one that says they cause a series of tactical and other problems that impact negatively on the core objectives—containing the fire quickly.

The key concern is the significant logistical problem of being able to place fire crews from these camps on the fire edge efficiently and early in the morning. Often crews have to wait long periods of time for helicopter transport (often delayed by morning weather) or long rides on bus transport. Crews often arrived on the fire edge after 9:00 a.m. only to be pulled back by fire behavior a few hours later. There is agreement that these large central camps do detract from the ability to maintain fire fighters on the fire lines during early morning and late evening periods. This was a key criticism from LFS and industry staff alike.

Other concerns include social issues (such as substance abuse) in the camps, as well as noise, security and the cost and time it takes to put one of these establishments in place. The LFS should continue to address these issues as required.

LFS is addressing the base camp issue and is looking at ways to get fire fighters to the line early in the morning, including re-establishing fireline tent camps adjacent to the fire and ensuring the Type I and II crews are self-sufficient for a period of up to 72 hours. Double crewing is another option being considered. The need to contract food and wash services and accommodations for pilots remains. The key issue is the ability to place suppression crews on the fire edge for the early morning and late

evening shifts. The 1999 initiatives and options being tested will focus on this concern.

Conclusion

Catered camps are effective in over-coming issues related to health and safety and allow the LFS to concentrate more on strategy and tactics.

The use of larger centralized camps creates serious barriers to deploying fire fighters on the fireline at first light and keeping fire fighters on the line until dark. This barrier is a critical issue as it relates to increasing the effectiveness of fireline efforts.

Recommendation

19. Address occupational health and safety concerns with respect to fireline camp arrangements—enabling increased use of fireline camps on sustained action fire campaigns. These concerns or issues include an exemption or modification of key requirements related to:

    - Food preparation at fireline camps.
    - Sanitation.
    - Tents/sleeping facilities.
    - Medical evacuation procedures.

    This recommendation should be pursued at senior executive level between a representative of the department of the Environment and the department of Labour.

4. Use of heavy equipment

The use of heavy equipment on fires in Alberta has been an effective tactic for many years and strategies have evolved to make the best use of this equipment provided by contractors and the forest industry. However, there were concerns expressed arising from the '98 experience.

"lack of service productivity – tankers with no fuel, cats with no radios or fuel – the contracting philosophy has taken over"

The key issues emerging in 1998 included delays in deploying available cats, inadequate fuel and servicing arrangements and the lack of radios to assign to the cat operations. These concerns can certainly be addressed and solved by the LFS and industry.

More importantly is the relationship with the forest, energy and power sectors. These industries want to be involved in providing heavy equipment service and want to be recognized as the providers of this specialized equipment both for initial attack and sustained action. They need to be directly involved in the future in on-going operational planning and fire line management. Additionally, in many cases, little ground support was available on the cat guards to secure the line with the result that many lines were lost and had to be rebuilt.

The Line Task group has addressed the issue. Their recommendations, when fully implemented will resolve most of the concerns experienced in 1998.

Conclusion

The LFS forest industry sector and energy sector are willing to work together to make optimum use of heavy equipment on fire suppression efforts. The main issue with respect to the heavy equipment in 1998 centered on communication and coordination between the LFS and the various industry participants.

Recommendation

20. Develop formal and regular systems for communicating with industry sectors on heavy equipment availability. Develop written protocols or enhanced fire management plans to address procedures to be followed for the coordination and use of industry equipment. Where equipment availability is high, develop dozer units where a single contractor would supply the Cat Boss and machines in each unit supplemented by a skidder or tracked vehicle with water and fuel tanks.

5. Burn-outs

The use of burn outs, particularly in support of cat lines has been a standard practice in Alberta. As well, this tactic is used to consolidate natural barriers and remove continuous fuel expanses. Two particular concerns have emerged from 1998. The first is that in many cases burn outs were not conducted on constructed cat lines, jeopardizing the control potential. Secondly, there is a different philosophy between government and the forest industry regarding the application of burn outs. The industry, concerned about conserving fibre, advocates burn-outs tight to the fire edge where as LFS often takes a landscape approach and undertakes the burn-outs a considerable distance from the fire edge.

Both points of view have some legitimacy and the LFS and the forest industry need to understand each other's point of view, and arrive at burn-out plans mutually when conducted on a Forest Management Area (FMA). This is a good tool and the Aerial Ignition Task Group has presented a comprehensive report and recommendations that address the logistics and training associated with burn-outs.

Conclusion

The burn-out operations carried out during the fire flap in early May were well executed and staff are to be commended for conducting these operations in a professional, safe and efficient manner.

Recommendation

21. Continue the use of burn-outs and emphasize the following factors when planning/implementing burnouts during fire suppression activities.

    - Ensure the big picture is considered when planning burnouts.
    - Use only experienced and qualified staff.
    - Allow for changes to be made to the burn-out plan as conditions dictate.

    Allow for the participation of the forest industry in planning burnouts when their wood supplies are impacted.

IX

Roles, Relationships And Communication

A. Introduction

Roles and relationships within an organization which is charged with the responsibility of conducting operations of the magnitude expected of the Alberta Fire Management organization must be clear, understandable and accepted by all. An organization of this importance and calibre requires a strong command and control structure, clear lines of authority, and focused accountability to adequately deliver the program.

Within the Alberta forest protection organization, various stakeholders such as forest companies, utilities, railroads, energy companies, and local governments, affect or contribute to the delivery of the protection program. Communication between parties, and open relationships are also key ingredients for the successful delivery of the program.

B. Background

The Provincial fire management program in Alberta has been fundamentally restructured twice since the 1992 - 93 fiscal year. These restructuring initiatives have been in response to province—wide downsizing of government operations, and direction for departments to adopt a more business like approach to delivery of Government programs. Generally staff within the Lands and Forest Service (LFS) have accepted the changes and challenges resulting from these downsizing initiatives.

There is general agreement, however, that although downsizing was necessary, some issues of appropriateness and functional delivery have emerged. This section will examine organizational roles, relationships and communications issues within Alberta Lands and Forests, and communications between the Provincial fire management organization and the contributing stakeholders who are partners in the overall delivery of the forest protection program.

Structure of the Alberta lands and forest service

1998 structure

The 1998 organization placed responsibility for the majority of program delivery in the field districts or areas. Forest Protection officers and technicians dedicated to the forest protection responsibilities managed the program while forest officers, who are "generalist" staff, largely delivered the fire program along with all other forestry based programs. The organization and responsibilities are presented in Exhibit IX-1.

As in the case of line and staff roles, the responsibility/authority/accountability/can fluctuate per task or activity. For example, the responsibility for opening and closing of lookout towers rests at one specific level—the district. Therefore, the accountability is at the district level. Fire billings (>$50,000.00) has three levels of responsibility, and authority; district to recommend, region to audit-approve; and provincial level for final approval. In this case, the accountability resides at the provincial level.

1999

The 1998 organization overloaded staff in some of the 17 districts which were responsible for management and delivery of nearly all processes in fire management at the field level. This realization prompted the LFS to consider some form of enhanced support for districts. Districts were forced to prioritize all issues internally and divide their efforts between initial attack and sustained action, while attempting to keep Regional and Provincial priorities in mind. In addition, this continually busy responsibility detracted from the ability of field staff to liaise with stakeholders in a meaningful way.

In 1999, the LFS created ten Fire Centres to ensure that Regional and Provincial priorities are continually monitored, provincial suppression resources are optimally utilized, and the provincial initial attack capability is maintained within established standards defined by the PPS system. The 1999 organizational model is presented in Exhibit IX-2.

Exhibit IX-1
1998 roles and responsibilities for each of the three levels per discipline

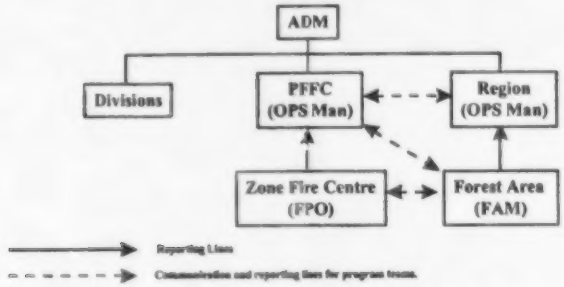
Line and staff relationships are a key factor in establishing roles and responsibilities:

- *Line personnel are responsible for the organization's results (who/how/when/where).*
- *Staff personnel are responsible for advising and assisting line management to advise better results (why/what/where).*

It must be remembered that this line/staff relationship can and does fluctuate, not only between the three levels (PHQ/RHQ/DHQ) but also internally within a specific operational level. This change of role between line and staff responsibilities can vary with the task at hand or for a given activity. For example, district Forest Protection Technicians act in a "line" role from a provincial perspective, but can act in a "staff" role while interacting with Forest Officers in district. For this reason, specific roles and responsibilities for the three levels of operations in Forest Protection are listed.

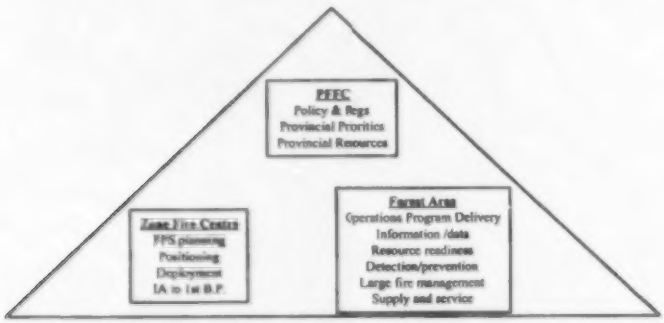
	Responsibility/authority	Fire accountability
Provincial	• Broad direction and policy. • Pool of science and planning expertise. • Legislation. • Central administration where practical and feasible.	• Policy direction.
Region	• Coordination of district delivery. • Regional direction and policy implementation. • Issues management. • E.R.C. • Contact to local governments, agencies, etc. • Maintaining relationships with stakeholders.	• Technical advisor and monitor. • Monitoring.
District	• Program delivery. • Hands-on forest stewardship. • Forest Protection. • Integration—operational decision making at the field level.	• Front line accountability.

Exhibit IX-2
1999 forest area fire centre reporting lines during fire season



Within the new organization, Forest Areas are still responsible for field delivery of the protection program, however, the Fire Centres will provide valuable co-ordination of effort regionally, and provide assistance and resources to Forest Areas as situations develop. Generally, the LFS Protection Program will now be delivered within a three tiered structure as depicted in the following exhibit.

Exhibit IX-3
Fire centre models and reporting lines



The Provincial Forest Fire Center (PFFC) has responsibility for Provincial priority development and application, program design, provision of all support functions, technology development, and allocation/co-ordination of all Provincial resources. This responsibility has not changed throughout the former or new organizational structures.

The Forest Area is responsible for field readiness and delivery of the program, and also has responsibility for stakeholder liaison and pubic information. An important feature of

Forest Area program delivery is the retention of responsibility for sustained action on fires. Specifically, the Forest Area takes charge of all escaped fires - utilizing resources provided by the Fire Centres and the PFFC. The Forest Areas are no longer responsible for prioritizing initial attack resources or dispatch of initial attack.

The Fire Centres are designated as "service centres" to the Forest Areas. Their principal role is:

- To develop and implement the Provincial Preparedness Plan.
- Prioritize initial attack resource deployment.
- Dispatch of initial attack.
- Support the acquisition of resources for initial attack and sustained action.
- Provide logistical support for all Forest Area sustained action.

C. Issue analysis

The 1998 organization wherein 17 separate Forest Areas were responsible for management and delivery of the entire program at the field level (including prioritization and dispatch of provincial resources) significantly "flattened" the organization, placing most of the responsibility and activity at the Forest Area level.

Flattening of organizations and de-centralizing program delivery, has often been considered as an effective method of downsizing. This process has been favored by large and mid sized companies who deliver more specialized or single purpose products and services. This "flattening" generally eliminates middle mangers, in favor of increased strength at the district or branch office. Management of initial attack, sustained action and Forest Area liaison with stakeholders, were not problematic during the relatively benign 1996 and 1997 fire seasons.

The overwhelming problems posed by the 1998 fire season would have taxed any Provincial fire management organization, as no single agency in Canada has the resources to handle a situation of this magnitude and duration. This "flattening" of the delivery process did not appear to consider the weight and number of decisions required of a relatively small Forest Area managing staff. As a consequence, some Forest Areas rapidly overloaded when faced with significant fires which threatened communities and whole industries. This overload created stresses within some forest industries, who rapidly lost

the ability to communicate with key LFS personnel and participate in the suppression effort in a manner which was satisfactory to them. In addition, requests from 17 Forest Areas to the PFFC and independent suppliers created a climate for confusion.

To their credit, LFS staff tackled the situation with dedication and enthusiasm. There was a realization that issues of communication, liaison, forest industry direct suppression, line support and logistics needed to be addressed. The new organization was created to strengthen key areas of prioritization, resource allocation, and support for Forest Area delivery of the protection program.

Conclusions

The new (1999) organization will increase the ability of the LFS to deliver the forest protection program. Strengths will be:

1. The PPS system and initial attack will be managed continually by the Fire Centers. Any process which strengthens and maintains initial attack will be of significant benefit to the Province. This process will dedicate significant resources and effort to initial attack, thereby more fully realizing the benefits of a state of the art Preparedness System.

2. On site tactical decisions will continue to be made at the field level, with increased support to field staff through the ten fire centres.

3. Lines of communication continue to be short. Area staff are able to communicate and debate issues directly with fire centers who will co-ordinate requests and facilitate logistics.

4. Forest Areas will no longer overload the PFFC and each other or suppliers with requests and individual debate for allocation of resources.

5. Forest Area managers and forest officers will be relieved of the continual need to be in attendance for initial attack. This will allow for development of meaningful communicative processes with stakeholders. It's recognized that the forest areas must retain the capability for a forest officer to carry out fire assessments as required.

Along with the obvious strengths of the revised organization, some areas of concern have been identified. These are:

1. Authority and accountability. The establishment of clear lines of authority and focused accountability remains an issue. Within the LFS, the Forest Areas report directly to Regional Managers who, in turn, report to the Assistant Deputy Minister in charge of forestry programs. When the Forest Areas are delivering the fire program, they report to the PFFC - which is responsible and accountable for the design and delivery of the forest protection program. Thus, it appears that **both** the Regional Managers and the Director of the PFFC are responsible and accountable to the Assistant Deputy Minister for the delivery of the fire management program in Alberta.

2. Although there will be a year-round presence in the fire program within the ten fire centres, there is no increase in the year-round dedicated staffing to the fire management program within the Forest Areas. Each district will continue to employ full time Forest Protection Technician. The protection of a resource which is so significant to the economy of the Province of Alberta, warrants a higher level of year-round dedicated staff in all possible field locations. During the "cooler" periods of the year, dedicated fire management staff would engage in important liaison, pre-suppression, prevention, enforcement and training programs.

3. LFS, forest industry and other stakeholders must become familiar with the new processes brought about by changes in organizations and roles. Some initial confusion will be the likely result.

Recommendations

- More clearly define the roles of the Regional Manager and Forest Area Manager in the fire management organization in order to ensure direct participation and to ensure unity of command and accountability.

- Consider establishing a higher level of year-round dedicated staff in the forest protection program within all Forest Areas. The higher level of staffing should reflect the results of the analysis carried out in Part II—the level of protection appropriate for Alberta.

- The Director of the PFFC and Regional Managers must collaborate and dedicate their efforts to swiftly resolve issues of responsibility and authority between forest areas, regions, fire control zones and the Provincial Forest Fire Centre during the initial years of operation.

- Performance measures and continuous improvement initiatives at the forest area level should include fire management responsibilities as part of the personnel performance agreement.

These recommendations are all further dealt with in Part II of the review.

X

Inter-Jurisdictional Comparisons

When conducting an evaluation of organizational and communications issues, a comparison to other successful organizations is often useful. A comparison was possible by drawing upon information gathered from the provinces of British Columbia, Saskatchewan, and Ontario to compare their organizational concepts to those of Alberta. General descriptions of these jurisdictions follow.

A. British Columbia

In 1995, The British Columbia Forest Service created a "Special Operating Agency" (SOA) to deliver the Forest Protection Program. The program undertook a significant re-engineering initiative resulting in[2]:

- A flattened organization.
- Well defined goals and objectives.
- Six provincial fire centers—reduced from 50.
- One provincial air tanker center—formerly seven.
- Two equipment depots—reduced from six.
- Centralized payroll and accounts payable functions—eight offices from 50.

This new organization operates independently from forest districts and is called the British Columbia Wildland Fire Service. The SOA is hosted by the Ministry of Forests and headed by a chief executive officer (CEO), currently the Director of the Forest Protection Program.

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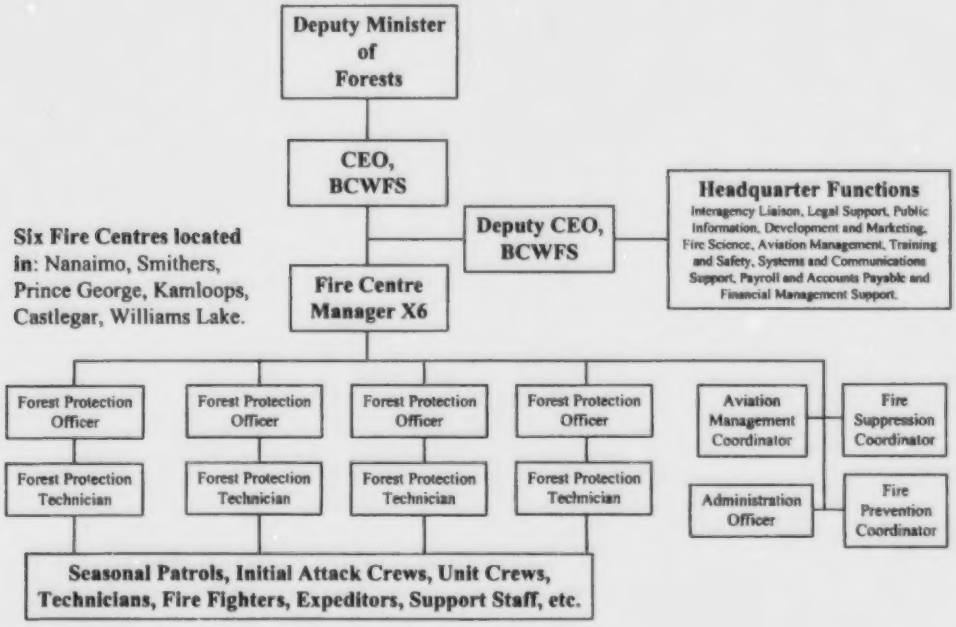
[2] *Reproduced by permission—SOA framework agreement.*

In establishing an accountability framework, the CEO is accountable to the Deputy Minister and reports directly to his office. The six fire center manages report directly to the CEO and are responsible and accountable directly for delivery of the forest protection program in their areas. Exhibit X-1 illustrates the structure of the BCWFS.

Exhibit X-1
British Columbia Wildland Fire Service Organization (1995 - present)



B. Saskatchewan

Following the costly fire season of 1995, the Province undertook a comprehensive policy study. Prior to and including the 1995 fire season, the fire program was delivered by an operational arm of the department—supported by a central policy and co-ordinating group. The 1995/96 policy study determined that the organizational structure was "not serving Saskatchewan Environment and Resource Management or the fire program well."

The primary issues cited were:

- Accountability for results is diffuse.

- Command and structure is weak.

- Span of control is excessive—8 or 9 levels from FPW (firefighter) to the Deputy Minister. Four levels from a C.O. (Conservation Officer) to the Regional director.

- Fire management program is only a priority during the active fire season.

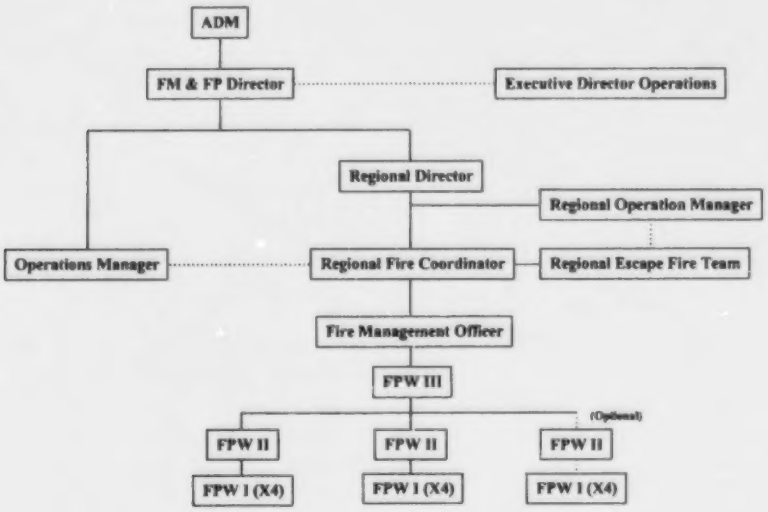
Two significant recommendations resulted from the Saskatchewan report:

- Adjust the organization and place the planning, delivery and accountability for the fire management program within the Forest Fire Management Branch.

- Additional full time staff need to be assigned to the field delivery of the fire management program. Given current fiscal events, a reassignment of existing personnel rather than adding to the payroll burden is appropriate.

Coincidentally, the Province of Saskatchewan was also in the process of downsizing. Various options including specialization or single agency delivery, with "flattened" organizations, were being actively debated. In keeping with the policy recommendations, the provincial fire management organization consolidated command, control, and accountability within a dedicated group reporting directly to an Assistant Deputy Minister. This structure resolved all of the organizational issues raised by the policy study. The new organization has functioned well in subsequent years and has received enthusiastic approval of forest industries and other stakeholders. Exhibit X-2 illustrates the structure of the Saskatchewan Fire Management Program.

Exhibit X-2
Saskatchewan fire management flow chart (1996 - 1999)



C. Ontario

The Ontario Ministry of Natural Resources (OMNR) has consolidated command, and control of fire fighting resources. Ontario believes this gives the organization flexibility and freedom to make the best use of it's total fire fighting capability. The Ontario model is a stand-alone system, operating within the OMNR organization. The system is capable of meeting all fire management objectives during normal activities without burdening the rest of the organization.

There are four levels within the "Ontario Fire Response System:

- Fire.
- Fire Management Headquarters/Attack base.
- Regional Response Centre.
- Provincial Response Centre.

There are three Response Centres; the Provincial Response Centre in Sault Ste. Marie, the West Response Centre in Dryden, and the East Response Centre in Sudbury.

Accountability is assigned progressively within the Provincial Flood and Fire Management Section of the OMNR through the manager (Director) of the entire section. Exhibits X-3 and X-4 illustrate the structure of the Ontario fire management section.

Exhibit X-3
Ontario flood and fire management section (1999)

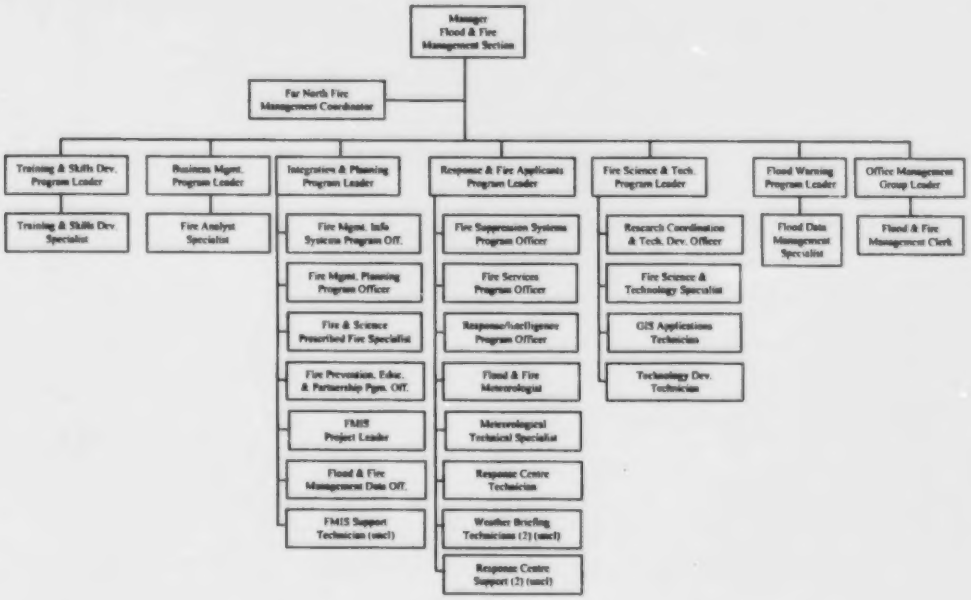
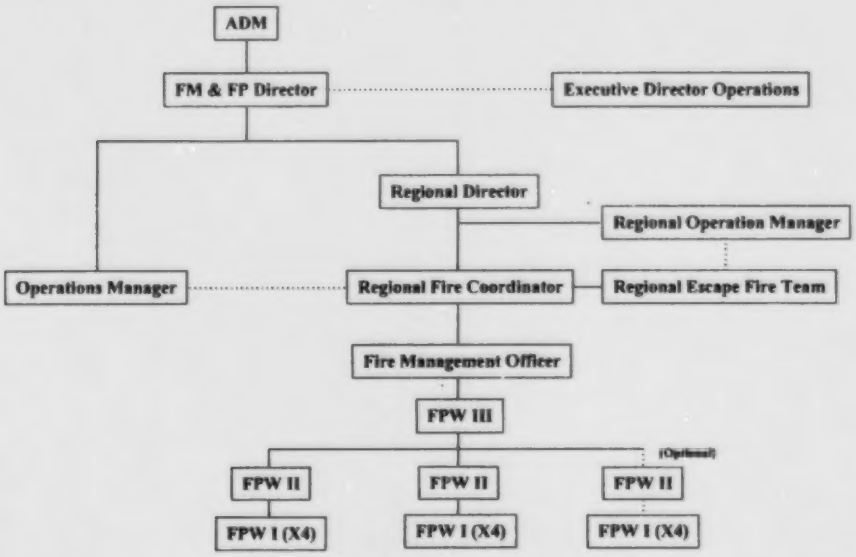


Exhibit X-4
Ontario response system reporting relationships (1999)



Conclusion

It is significant that all three of these jurisdictions have grappled with the necessity of public sector downsizing since the middle of the current decade. All of the agencies flattened and consolidated their operations. All agencies have provided some form of staff dedication to forest protection on a year-round basis in field locations, and all agencies have placed tactical decision making in the hands of the staff who deliver the program.

These comparisons demonstrate that the Alberta Lands and Forest Service is not alone in it's need to re-organize for the purposes of downsizing, while attempting to strengthen programming to meet current and future protection demands.

The significant issue within the new Alberta fire management organization is one of apparent dual accountability from field districts to the ADM level. The idea of a single command structure within the fire program—together with apparent dual reporting relationships for the staff who carry out the program, may be cause for some questions of authority at the field level.

Based on structures and reported successes of the organizations examined, it appears that delivery of the fire program, primarily through generalists in the field, is not mainstream thinking. A break with mainstream thinking isn't necessarily wrong, however, other provinces have dealt with the need to downsize while delivering an increased level of protection by dedicating staff to fire protection programs.

The need for an increased level of protection is made necessary by growth of the forest industry, encroachment of oil, gas and power utilities, and rural/urban settlement within forests. In addition, there is increasing evidence that Western Canada is experiencing the effects of global warming, thereby increasing fire hazards, lengthening fire seasons and gradually changing fuel types.

D. Forest industry sector

The issues of Roles and Communications as they pertain to the forest industry in Alberta, are as diverse as there are companies. A considerable amount of time was spent ensuring that the majority of forest industries were consulted. A total of 18 companies were consulted. In the process of this consultation, a number of common issues pertinent to forest industry relationships and communicative processes have emerged.

There is a general air of disbelief of the necessity to downsize and re-organize the LFS Forest Protection program—in any manner which has changed the organizational structure of the pre 1992 LFS organization. The primary issues for companies which experienced significant losses in 1998, are directly related to the downsizing and subsequent re-organization initiatives.

A number of companies have expressed fears that the downsizing initiatives will lead to government off-loading of some aspects of the forest protection program. The serious losses of timber are often highlighted as the result of reductions in numbers of experienced staff, through early retirements and other incentives.

The forest industry wants to clarify their role in future forest protection initiatives. Most companies want to become involved, but are apprehensive about their level of commitment and consequent financial liability. Companies are unanimous in their belief that a single agency should remain responsible for fire suppression. The companies are also unanimous in their belief that this single agency should be the Government of Alberta, which is seen to be the logical and best protector of public forest resources.

Companies also undisputedly agree that protection of human life and community should be the primary objective of the program. Beyond this primary objective, there is also agreement that local stakeholders should be involved in setting local priorities for protection of resources.

Generally speaking, companies and local LFS staff have a good working relationship. Conflicts do arise with respect to planning requirements, especially when there are some internal differences between local and regional applications of policy. In addition, centralization of some LFS functions has a perceptible impact on the interaction and relationships between forest companies and the local LFS, as the local offices are seen to be hindered by occasionally misunderstood regional objectives. The key point is that forest companies would like to be recognized as responsible for planning, harvesting, and directing the regeneration of the forest on their FMA, while the LFS should focus on protecting the sustainability of the resource.

The industry generally believes Alberta has an excellent prevention, pre-suppression, detection and initial attack system. Some industry observers, however, believe the system begins to fail in sustained action situations. There is a perception that the AFS has not resolved internal issues pertaining to fireline staffing, logistics, specialized support and utilization of industry personnel and expertise.

The industry is aware and accepting of the need to become involved directly in the forest protection effort. More specific and pre-arranged involvement is requested, along with LFS recognition and acceptance of industry skills. Company staff do not want to be considered sub-standard and required only as a support or last call group.

Conclusion

Although the forest companies appear to be united in their questioning of the necessity to downsize and re-organize the LFS, not all companies feel as strongly that the LFS cannot adequately handle sustained action fires. All companies suggest that the downsizing initiatives, which effectively reduced the ranks of experienced fire managers and technicians, were not in the best interests of the fire management organization in Alberta. There is genuine recognition, however, that remaining staff are dedicated and capable of rapidly learning the intricacies of fire management in Alberta.

There does not appear to be genuine acceptance among all LFS staff, of the need to incorporate industry staff and equipment directly into the fire management organization. On the other hand, some forest companies have been reluctant to commit resources or effort on an ongoing basis. They appear

to have preferred instead, to insist upon a provincial obligation to deliver the fire program, with only minimal participation as requested in support of specific fire line operations.

There is obviously insufficient communication between LFS Forest Areas and forest companies. Forest companies do not appear to have received sufficient briefings on new organizations and operational policies as they have been developed. On the other side, some forest companies do not appear to have willingly or consistently participated in information or briefing sessions.

The industry has indicated a willingness to become involved in the process of fire management and suppression, provided that their involvement is planned and agreed in advance of action requests. In addition, industry staff generally insist that their commitment is primarily in support of operations on their own holdings. It is apparent that there needs to be some discussion or agreement on these matters if industry staff are to be truly recognized and accepted as "first responders" rather than a support group.

There is agreement by both industry and LFS that new fire managers in Forest Areas need to work hard at local communications and information sharing with the industry. New fire managers (ie. to the areas or roles) must become familiar with all local priorities and demonstrate their desire to act swiftly in the protection of all forest assets for the benefit of their community and local industry. This, in turn, will demonstrate that the province is always doing everything possible to handle it's fire problems.

Some companies have actively participated in the process of fire management to the point of establishing fire crews, equipment caches, training programs, helicopter contracts and very active and meaningful fire plans. Others have not developed to this degree due to financial constraints or philosophy which insists upon Provincial delivery of the fire program in its entirety. There is a need of both the industry and the LFS to recognize the importance of industry personnel in delivering the fire protection program. This requires genuine commitment from both parties. Financial implications of this process need not initially be a deterrent, as reasonable discussion and acceptance of mandates will soon provide solutions.

Recommendations

22. Actively solicit forest industry assistance and involve forest industry staff in pre-suppression planning.

23. Encourage willing participation of industry staff in providing assistance and pre-suppression planning as required. A certain level of training and time must be invested in woodlands staff to support this initiative.

24. Establish planned communicative relationships at Provincial and Forest Area levels to ensure a comprehensive understanding of the protection program throughout the year.

25. Continue and expand the industry Liaison Consultant program to ensure accurate and timely exchanges of information and participation by industry in the process of forest protection in Alberta.

26. Continue to incorporate industry staff directly within the fire management system in Forest Areas, to ensure timely and expert response to developing fire situations. The two current industry liaison positions are successful and should serve as an example of effective government-industry cooperation and coordination.

XI

Logistics And Support

A. Introduction and background

In fire management, logistics and support refers to the procurement, maintenance and transportation of material, facilities and personnel. Specific reference is made to the supply of all hardware and services to fire management personnel whatever their role or situation.

The majority of logistical processes are planned and delivered within the 'pre-suppression' discipline of a fire management program. Once the actual firefighting begins, the logistical plans are executed according to pre-arranged functions, policies and processes.

The effectiveness of program logistics invariably affects the outcome of the program or required action. If essential equipment, personnel and services are not available or do not work, firefighting cannot occur.

B. Issue analysis

In the course of interviewing LFS and stakeholder representatives, several logistical or support issues were raised. The issues were all previously raised and discussed in past season debriefings and meeting. As a result, the LFS created internal task groups to identify key issues and propose solutions. Most of the issues brought forward in the interview process were addressed by task groups. The issues and task group general recommendations are discussed in the following paragraphs.

1. Radio communications

Both the LFS and forest industry representatives raised the issue of insufficient numbers of radios to facilitate essential fireline communications.

The Plans Task Force Report dated February 23, 1999 dealt with this issue in detail They reviewed the number and type of radios required for all fireline situations. Recommendations from this task force have resulted in 1000 new purchases to ensure adequate fireline communication in the future. In addition, the LFS will provide an enhanced radio network at considerable cost over the next three years. Definite cost estimates are not available at this writing.

The LFS has recognized the need to increase the numbers of radios, and the need for an enhanced communications network. Commitments have been made, and the work of the Task Force and decisions for action by the LFS should be commended.

Recommendation

27. Develop the planned enhanced radio network (Alberta Firenet) as a priority in the 1999/2000 fiscal year.

2. Transportation of suppression crews to and from firelines

In actuality, this issue is one of ensuring that firefighters are on the fireline during all available daylight hours rather than working standard shift days.

The line task group final report dated February 26, 1999 addressed this issue and has proposed solutions which will be adopted in 1999. The LFS appears committed to ensuring that firefighters are on the line when it is necessary and safe to do so.

3. Support of heavy equipment

Fuel maintenance, communication and direction is lacking with respect to heavy equipment support. The line task group and a focused heavy equipment task group jointly dealt with this issue. Copies of the heavy equipment task group final report have not been available for review, but a summary of detailed issues indicates that extensive work would have to be done in this subject.

We are confident that the task groups will have operating policies and processes in place for the 1999 season. The item will be confirmed and analysed in the final report.

4. Servicing large camps

This issue is one of understanding the special needs and demands of supporting large fire camps. Issues of staff support and equipment acquisition, and management emerge here.

A Service Task Group was commissioned to address this issue, and has produced a report. It is apparent that the previous issue is the effective management of contract camps and facilities. The report was not final at the time of this review.

5. Mutual Aid Resource Sharing Agreement (M.A.R.S. Agreement)

There is an understanding that no province has sufficient equipment and personnel to handle a severe and extended fire season by itself. In order to share resources between Provincial and Federal agencies, the M.A.R.S. Agreement was created under the auspices of the Canadian Interagency Forest Fire Centre. This agreement facilitates loan and shipment resources across all jurisdictional borders in Canada.

In the history of the 13 year old agreement, Alberta has been a net exporter of fire equipment. This trend was dramatically reversed in 1998. Details of items borrowed or loaned are provided in the appendix. The main issue for Alberta lies in an analysis of available equipment to meet current and future demands for fire protection as well as establishing a resident threshold of WFU inventory.

Exhibit XI-1
Personnel imported to Alberta

Exporting jurisdiction	May	June	August
USA	710		101
British Columbia	536	194	
Manitoba	21	2	40
New Brunswick	10		
Northwest Territories	11		
Ontario	33	100	111
Parks Canada	1		1
Quebec	82		
Saskatchewan	137	1	246
Totals	1521	297	499

Note: not in totals.
3-20 man units on standby in BC for long weekend.
56 personnel from the Military on Virginia Hills.

Exhibit XI-2
Aircraft imported from out of province - 1998

	CL215 Groups	Electra	Infrared aircraft	737
USA			3	1
British Columbia		1		
Manitoba	3			
Ontario	1			
Northwest Territories	3			
Quebec	1			
Saskatchewan	1			
Totals	9	1	3	1

It is evident that this issue is related to projections of future demands by communication and industry in the face of certain global warming. It is probable that the entirety of Central and Western Canada will be faced with increasing fire season severity as our continent warms up. Further analysis of this issue is provided in Part II of the review.

6. Suppression equipment inventory levels

This issue is related to #5 (above) in a general way, and more locally, is a question of management of equipment which is owned and stocked in Alberta.

The fireline equipment task group was asked to review three items which are:

- Use of small pumps.
- Stocking of small (5/8") hose.
- Review of the use of water thieves.

IComments indicated that repairs were generally inadequate, that appropriate equipment was not always readily available, and that the substantial losses or damage of fireline equipment were experienced.

A review of 1998 fire debriefings, and discussions with LFS personnel have revealed that inventory and quality control issues are real, and that the LFS is aware of the problems. Consequently, an effort to implement control processes is underway in 1999.

A preliminary review of provincial equipment inventories reveals generally adequate stocks of equipment located in warehouses throughout Alberta. The LFS needs to ensure a detailed accounting of actual losses in 1998, and a review of 1999 equipment levels is warranted to ensure firefighters have all of the tools necessary to do their jobs.

Recommendation

28. Complete a detailed accounting of actual equipment losses in 1998, and a review of 1999 equipment levels is to ensure that equipment inventories are adequate for subsequent years.

7. Wild land fire fighting units (WFU's)

IN 1996, the LFS initiated a program which was intended to improve the efficiency of Alberta's ground fire fighters. The program was also intended to move the provision of ground fire fighters into the private sector over a five year period. A business strategy was developed through a consulting contract (C. B. Smith, C.A. Dermott—Forest Firefighting Business Strategy for the development of Wildland Forest Firefighting Units in Alberta, January, 1997).

The majority of recommendations contained in the report were adopted beginning in the 1997 fire season. The main features of the program are:

- Parameters around pre-qualification, training, fitness, fire line capability and crew configuration were defined.
- Capabilities to perform no-fire project work were defined.
- Proposal to move the program to the private sector with minimum tenures and competitive bidding.
- Staged implementation providing complete delivery of the program by the private sector within five years.

Conclusion

The program is now nearing it's third year of implementation and the LFS has experienced some problems with implementation such as: competitive versus non-competitive contract awards, political issues, crew rating, additional charges, over-time tracking and vehicles.

The list is but a few of the many issues encountered. Appropriately, the LFS has decided to review the delivery of the program and review it's effectiveness/ appropriateness after the third year of implementation in 1999. A contract tender for the review has been developed and the review will be completed by October 31, 1999.

The development of a contract process for provision of fire fighters and forestry workers is valid and desirable process in today's competitive world. The LFS should be commended for their diligence in this issue.

8. Air operations

This item refers to adequacy of airtankers and future development. Alberta has a well established and competent air attack organization. New contracts have been developed for 1999 to replace one A-26 group with three new turbine-powered airtankers. In addition, Alberta's current CL-215 operator has become the first "private sector" purchaser of CL-215 aircraft in North America. This has added two more CL-215 to the fleet.

It is certain that airtankers will be required in greater numbers or capability, as increased demands for protection are realized. Due to the reality of distance and isolation of most forest land, airtankers are the "first responders" to many wildfires throughout the nation, and certainly within Alberta.

The LFS is looking ahead, and supporting future developments by upgrading six airstrips. LFS is also considering aircraft upgrades and development in a general way. These measures and discussions indicate commitment to supporting fire-bombing concepts well into the future.

Some specific issues of concern were raised during interviews with LFS and forest industry staff. These were:

- Air-tankers were out of position during critical situations due to action in more northerly community areas which are not within the provincial forest.
- Control of air-tankers was often confusing due to inadequate unit location knowledge, and some command/control confusion.
- Some instances of air-tankers action without any, or adequate, follow-up.

In response to the concerns the LFS has resolved issues of command / control through creation fire centers, and have imported and implemented a state-of-the-art aircraft tracking system.

Conclusion

The first item is a significant issue and is discussed in detail in Chapter VI. Commitments outside of intended or planned/designed program areas detract from the organization's ability to deliver a timely and effective aerial attack in Alberta's wild lands.

The issue of control and location knowledge has been identified as a significant issue as well, and the LFS has moved to resolve this issue by importing a state of the airtanker tracking system. The LFS should be commended for it's immediate attention to this important matter.

The issue of inadequate follow-up is largely anecdotal and further discussion and confirmation is necessary to ascertain the authenticity or rationale. Issues of expediency and priorities are likely to emerge here.

Modern fire management in Canada dictates the use of an optimum mix of fixed and rotary wing aircraft to provide essential first action on wild land fires. Road access in rural Canada is not a viable option in most cases, as reaction times over greater distances are not sufficient to do the job. Aerial fire control equipment is costly, and often amounts to as much as 30% of the total budgetary and extra expenditures. The future direction of the airtanker fleet is addressed in Part II.

Part II

Policy Review

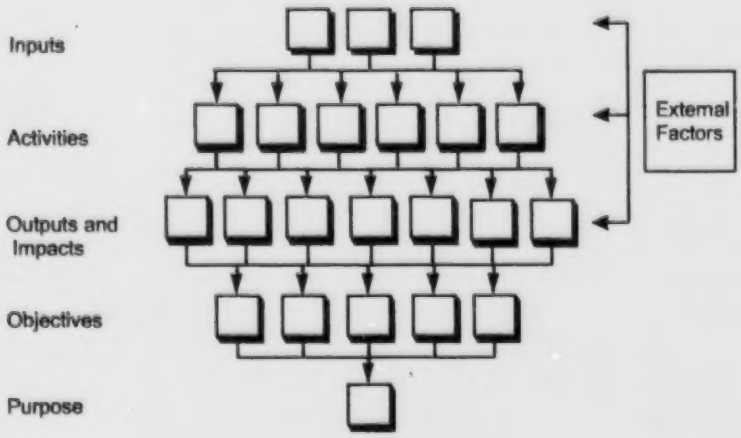
XII

Introduction

Part II of the Alberta Fire Review focuses on the policy considerations and broader program issues that concern industry, government and public as a whole. In this report a number of policy and program issues are addressed that go beyond the performance of the Land and Forest Service (LFS) in any one particular year. These issues address key matters associated with public policy, priorities and societal values.

Parts I and II combined are intended to cover the full range of issues identified through the Program Review Logic. The logic used to assess the Forest Protection Program is given in Exhibit XII-1.

Exhibit XII-1
Program review logic



Included in this report are an assessment of the following:

- Level of protection appropriate for Alberta, including:

- Purpose of the Forest Protection Program in Alberta.
- Program goals and objectives.
- Values-at-risk.
- Protection priority.

- Level of funding appropriate for Alberta, including:
  - Theoretical basis for funding forest protection.
  - Recognizing values-at-risk.
  - Comparative analysis of forest protection expenditures.
  - Funding the forest protection program—who should pay?

- Integrating fire management with landscape management practices.

- Organizational issues, including:
  - Issues with current organization and structure.
  - Organizational alternatives.

- Aboriginal communities, including:
  - Aboriginal and treaty rights.
  - The importance of building lines of communication and partnerships.

- Reducing industry impacts on fire hazard and risk, including:
  - Logging activity.
  - Silvicultural operations.
  - Seismic programs.
  - Pipeline construction and operation.
  - Powerline operations.
  - Agriculture.
  - Recreation.

- Mutual Aid Resource Sharing Agreement and Alberta's Strategic Reserve of Fire Fighters.

- Environmental factors—climate change and fire regime.

- Role of airtankers in forest fire suppression

- Communications, continuous improvement and performance measures.

- Forest Protection Agreements.

Conclusions and recommendations are presented in each chapter, where they relate to the issues being discussed, in an effort to help the Land and Forest Service improve on the Forest Fire Protection Program being delivered.

XIII

Level Of Protection Appropriate For Alberta

A. The purpose of the Forest Protection Program in Alberta

Wildfire has always been a significant factor in Alberta's forests. Fire clearly played a dominant role in the past (before intervention by man) in the determination of landscape patterns, age class distributions and other characteristics of our forests. As Alberta became settled, a number of reasons for protecting our forests from wildfire emerged. These reasons included the protection of:

- People.
- Private and public property.
- Investments in an emerging infrastructure.
- Valuable resources, particularly key watersheds and timber resources in the east slopes area.

In the early years of forest protection in Alberta, emphasis was placed on settled areas where people would be most affected by the destructive force of fire. People's lives were at stake where fire threatened homes and communities. In the more remote portions of the province, typically in the north, less emphasis was placed on forest protection.

As the province continued to develop its natural resources, both in the central and northern areas as well as the foothill areas, settlements grew and the dependency of communities on forest resources increased. Over time, it was clear that the Forest Protection Program would have to evolve and offer protection to people, property and public resources in all parts of the province where people had a stake. Today, we have a Forest Protection Program that has, as its primary purpose or mandate, the containment and extinguishment of all forest fires in the province, with an emphasis on any fire that has

the potential to threaten public safety or to destroy property and/or resources. In effect, this mandate takes into account almost all of the province's forested area.

In response to this broad sweeping mandate or purpose, Alberta has developed its Forest Protection Program to a very extensive level based on a complete system of:

- ***Detection*** using fixed towers, aerial patrols and an industry/public reporting system.
- ***Pre-suppression and preparedness*** using man-up crews, air tankers and other aircraft and equipment.
- ***Rapid initial attack*** capability based on highly trained initial attack fire crews, rotary wing aircraft and aerial delivered suppressants.
- ***Fire suppression*** capabilities, based on wildland firefighter unit crews, contracted aircraft and extensive equipment warehousing and distribution systems.
- ***Fire prevention*** aimed at reducing fire hazard and risk in key locations, such as near communities and at the wildland/urban interface.

The challenge today is in confirming where the purpose and mandate currently stands and the extent to which it can be effectively applied in today's context. In addressing the question of the level of protection appropriate for Alberta, a number of specific considerations must be addressed including:

- Program goals and objectives.
- Values at risk.
- Priorities.
- Various levels of protection that might be appropriate in specific circumstances.

The following sections briefly discuss issues around each one of these key considerations based on interviews with government leaders, key stakeholders, and Forest Protection Program managers and experts.

B. Program goals and objectives

Goals and objectives were identified in Part I of the review as they related to the four major disciplines within the Forest Protection Program. At a broad level, however, the program goals and objectives are given in department of Environmental Protection's business plan and annual report as:

- "Protecting and managing Alberta's natural resources and ecosystems for present and future generations".

The business plan also identifies one of the high level strategies aimed at delivering this goal as:

- "Reducing the impact of natural hazards (fire, drought, flood, pests) on people, property and resources".

These high-level statements, adopted by government in its business planning process, have been translated into a decision to provide a very high level of forest protection across the entire province. Alberta has no areas or zones identified where different levels of protection are provided and has no variation in performance measures for initial attack and containment. As a result, decision makers directly responsible for the program, have interpreted the objectives stated by government as support for an aggressive forest protection program across the entire province.

The experience of 1998 has raised questions about these goals, objectives and high level strategies of the Forest Protection Program and about the manner in which these goals are interpreted. A particular concern is how these interpretations are used to justify or determine the level of protection appropriate in Alberta. Returning to the policy statements (high-level goal and strategy) stated above, it cannot be said that they provide the basis of a mandate for full protection across Alberta. The stated mandate is to "reduce the impact" of natural disturbances. With a closer investigation of the high-level policy statements, one can derive a number of key points which are more appropriate interpretations to guide the level of protection appropriate for Alberta. These key points include:

- Wildfire will always occur on the forested landscape and will always have an impact on people, property and resources. The goal of the program is to minimize the impacts, not to eliminate the impacts.

- Forest protection supports a greater objective of ensuring that ecosystems and resources are healthy and functioning for present and future generations.

There is an acknowledgement that protection is part of a greater landscape/ecosystem strategy and long term planning horizon—in addition to being an emergency response.

- Wildfire is a natural process similar in nature to floods, drought, insects and disease. Protection from natural disturbances or disasters is employed for similar reasons (safety, protection of property and resources) and is subject to the varied and sometimes powerful forces of nature.

The translation of the policy statements into a defined program, including an intentional level of protection, can only be done with an understanding of the values-at-risk and the sense of priorities by the public and stakeholders that have an interest in our forests. The following section addresses values-at-risk within the context of setting a level of protection for Alberta.

C. Values-at-risk

A number of resources and values are potentially threatened by wildfire in Alberta's forests and it is these values that ultimately lead to decisions regarding the level of protection provided or the specific strategies and tactics employed within the program.

It has become clear that the current model of full aggressive attack on all fires 100% of the time is not always feasible when taking into consideration the current fire regime, resource limitations and economic constraints. With this realization, there needs to be some means by which to prioritize fire events relative to the value of important elements put at risk by each fire event. These elements of values-at-risk include those with financial (e.g. private property, timber, infrastructure) and those with non-financial values (e.g. cultural artifacts, rare and endangered species, aethestics). Some examples of the values at risk in Alberta include:

- Human lives and the health and safety of people potentially affected by wildfire.
- Communities and homes of people living in or near the forest.
- Private property such as buildings and cottages and others.
- Public property and infrastructure such as power lines, communications sites, roads and others.

- Industrial facilities such as gas plants, mine sites and forest sector infrastructure.

- Timber—both standing timber and growing stock contributing to annual allowable costs.

- Non-timber resources such as recreation opportunities, wildlife, aesthetics, trapping areas, biodiversity/ecosystem integrity and others.

The consideration of the level of protection appropriate for Alberta must be founded on an assessment of values-at-risk and the priorities placed on these values. Some of these priorities can be evaluated in terms of economics—property and timber resources are an example of quantifiable values and opportunities to establish priorities. Aesthetics, biodiversity and wildlife habitat are examples of resources that are difficult to attach quantifiable values to and are more difficult to establish priorities for.

1. Property and infrastructure

Public and private property is not difficult to value in an financial sense. Replacement value, book value or some other generally accepted financial measure can be used to put a value on assets. Infrastructure, such as powerlines, roads, industrial facilities and others can all be valued in similar terms and the added dimension of lost productivity or lost economic activity can be included as well.

In many cases, private property has received much attention as a critical value-at-risk. While the economic measure of a value-at-risk for private property is the same as for any other property, the social aspect of losing homes and personal property adds an important consideration in evaluating risk.

2. Timber

Values-at-risk from a timber resource perspective focuses on standing timber value and Annual Allowable Cut (AAC) impacts. Cases are often made to justify forest protection efforts on the value of timber alone—both in terms of the loss of standing timber volumes and loss of AAC. This aspect is discussed in more detail in Chapter XIV.

A financial value can be placed on the standing volume of timber based on its worth in the marketplace or its residual economic value. This value can be used as a quantification of value-at-risk. The province, through its evaluation of timber values for the purpose of determining appropriate compensation rates for industrial land

clearings, estimates the market value of standing timber to be an average of $18.45 per cubic metre for coniferous standing timber and $1.53 per cubic metre for deciduous standing timber. Other studies have suggested that the financial value of coniferous timber may be $50 per cubic metre or more — deciduous timber may be worth $20 per cubic metre or more. The most appropriate figure to be used for a value-at-risk analysis should be a detailed revenue analysis.

Using an estimate from the provincial forest inventory database, approximately 1.4 billion cubic metres of conifer and 0.7 billion cubic metres of deciduous timber are standing at any one time within the province's forested area. This volume represents a potential value ranging from roughly $30 billion to $70 billion of standing timber at risk across the province.

While this is admittedly a broad range, it could certainly be tightened by a more formal assessment of the method of valuation appropriate for forest protection decision making and by a subsequent provincial or regional economic analysis. The assessment of values-at-risk for standing timber, however, is not complete without a more complete understanding of the true nature of the loss. In some cases, wildfire has a devastating impact on standing timber, particularly, where the timber is destroyed and not salvageable. In other cases, wildfire may have little effect on standing timber as harvest plans are changed to allow for the salvage of standing timber and the timber yields wood fibre of commercial quality. Wildfire may also have a beneficial impact on timber resources over the long term as it changes age class distributions in ways that may benefit future timber supplies.

The assessment of values-at-risk is also somewhat complex where wildfire affects Annual Allowable Cuts (AACs). In some cases, wildfire has a serious impact on AACs, especially where age classes critical to sustained yield timber supply planning are destroyed by fire. In other cases, wildfire may have little or no impact on AACs where fire burns unmerchantable forests, where forests are salvaged and reforested promptly, or where fire changes age classes within a forest to a more balanced distribution.

3. Other resources and values

Other values, such as wildlife, recreation and tourism, aesthetics, biodiversity, watersheds and others, can not be easily valued in a financial sense, but are equally important and deserve serious attention in setting priorities. Many of these resources and values can be equally enhanced or damaged by wildfire and any evaluation of values-at-risk must consider the net impacts of fire.

Ultimately, the essential definition of values-at-risk will ultimately arise from a combination of economic valuation and an assessment of societal expectations.

D. Protection priority

Historically, priorities have been established in terms of three broad levels of values. The first priority has been public safety; the second—public and private property; and the third—forest resources. A fourth priority, which has never been articulated but that is beginning to receive more attention by planners and decision makers in the near future, is the health and vigor of forest landscapes.

Other jurisdictions have evaluated this hierarchical approach to establishing priorities for forest protection and have concluded that forest resources are equally as important to society and stakeholders as public and private property. The priority is simply stated as public safety as the first priority and all other values as subsequent priorities, ranked according to the specific values-at-risk.

This flattened approach to prioritizing protection is appropriate for most jurisdictions. As a finite supply of natural resources from the forest become increasingly allocated to resource users, and as communities become more and more dependant on a fully allocated resource base, the ranking of values-at-risk becomes more and more difficult. One can not unequivocally state that property is necessarily a higher priority than natural resources given a resource dependent economy.

Our interviews with government leaders, MLAs, industry managers, local government representatives (towns, counties and MDs) and wildfire experts indicate general support for a flatter approach to establishing priorities provided that certain key considerations are maintained:

- Public safety continues to be considered first priority in all cases.
- Communities and homes continue to be considered a key value-at-risk.
- A value-at-risk approach to establishing priorities must include meaningful input from stakeholders in the area that protection is being provided for.

E. Conclusion

Alberta currently attempts to provide a very high level of protection across the entire province. While this has not been explicitly directed by the departmental business plan, it has been interpreted as such from the stated goals and strategies for protecting resources and ecosystems and from the traditional expectations of the Alberta Forest Service.

It is clear that forest protection must fully address public safety. In addition, it is prudent to consider homes and communities as key values worthy of a high level of protection, since these losses can have such a devastating impact on people's lives. Alberta has 321 communities located in or near provincial Crown forests and the subsequent demands for protection are significant.

It is not as clear that all forests require the same high level of protection. In areas where communities and homes are not a value-at-risk, forest protection accomplishes primarily resource management and utilization objectives—important objectives to be sure. It is possible that with the right information and decision processes, areas or specific fires could be identified as lower priorities and could receive fewer resources when confronted with resource allocation decisions.

Given the powerful nature that wildfire can have, the fact that wildfire starts often occur as multiple fires, and the vast area that the LFS is responsible for protecting, it is clear that full protection of the entire province in all wildfire situations is not always possible. Whether planned or unplanned, some fires will receive a lower priority and some areas will receive lower levels of protection during extreme fire situations.

The year 1998 is an example of a fire season that forces decisions regarding priorities and firefighting resource allocation. A balance must be struck between the protection of the most important values-at-risk and the cost or effort to attain that level of protection. In an effort to guide the province to establishing this effective balance, a number of policy recommendations are presented in the following section.

F. Recommendations

The establishment of a clear set of priorities and the full consideration of values at risk in the development and delivery of the forest protection program is essential. Priorities must be clear and fully supported by government and the methods of assessing values at risk must be state-of-the-art. There are too many stakeholders involved in the allocation and use of forest resources in Alberta for a very generalized approach to decision making and

assessing values for this reason. Recommendations to guide the manner in which the Alberta Land and Forest Service deals with the level of protection and priority issue are:

29. Modify the current set of priorities established for the Forest Protection Program to recognize that:

    - Public safety, communities and homes are first priorities.
    - Secondary priorities will be determined on a fire by fire basis considering all other values-at-risk.

30. Form advisory groups to develop formal definitions and other measures for non-financial values-at-risk. Each advisory group should include local representatives with an interest in the important non-economic values-at-risk specific to each region.

31. Continue to provide a very high level of forest protection across the Forest Protection Area of Alberta recognizing:

    - The large number of communities found in and near Alberta's forests.
    - The very high level of industrial development within the forests.
    - The very high level of timber resource commitment.

    Aggressive initial attack should continue to be the key strategy. It should be the norm for all areas of the province until the LFS has developed and tested a decision process that makes allowances for lower overall values at risk and modified response.

32. Delay any movement towards the use of zoning to guide different levels of protection until the financial and non-financial values-at-risk across the province are fully evaluated including consideration of extensive input from local or regional advisory groups from affected areas across the province.

XIV

Level Of Funding Appropriate For Alberta

To determine the appropriate level of funding for forest fire protection would require some understanding of the underlying principles of forest protection which are listed below:

- Avoiding the loss of human lives.
- Avoiding the loss of property.
- Avoiding and minimizing negative impacts on the economic well-being of the citizens.
- Minimizing the negative impact on the environment.

It is with these principles that government establishes and manages the Forest Protection Program. Through this program, government is engaged in both pre-suppression and suppression activities in relation to forest protection. These principles should also form the basis for developing measures for the appropriate level of fire expenditures justifiable for fire protection. However, as previously noted in chapter XIII, these principles do not lend themselves to a straightforward quantitative measurement. For example, it is difficult, if not impossible, to put a value on human lives. Similarly, the values associated with certain economic activities (i.e. hunting, fishing, bird watching, etc.) are difficult to quantify. Thus, it appears that an all-encompassing measure is not possible.

Furthermore, wildfires do have some benefits under certain circumstances—especially in rejuvenating wildlife habitat. However, little success has been made in modeling this type of benefit. The upshot is that it is difficult to develop a measure that can capture all the costs and benefits. In the absence of such measures, other measures need to be established.

A. An ideal measure—theoretical basis for funding forest protection

At a high level, the ideal measure for setting the appropriate level of forest protection expenditure can be defined. However this definition would require a value to be assigned to all damages prevented as a result of forest protection activities—damages to all values including human lives, property, wildlife and key habitats, recreation areas and others. The difficulty in assigning a value to averted damages is that the range of possibilities in damages and associated costs is virtually infinite for any given fire event. A valuation of averted damages would require a model that could emulate the same fire event twice—once without suppression activities and once with some level of fire suppression effort and expenditure. It is intuitive that the fire with suppression efforts applied would burn a smaller area and result in less damage than the fire with no suppression at all. It is the net difference in the economic value of these two scenarios that is required to calculate the value of averted damages.

If such a net value could be determined through the use of computer modeling (ie enhanced fire behavior models), then the ideal measure for forest protection expenditures could e calculated as follows:

- A/(B+C+D) where:
  - A = Averted damages.
  - B = Pre-suppression expenditure.
  - C = Suppression expenditure.
  - D= Net value change (defined as a net change in the resource value).

In this case, the ideal level is reached when A/(B+C+D) is equal to or larger than one; i.e.:

- $A/(B+C+D) \geq 1$

Through mathematical manipulation, this expression can be rearranged as:

- $B+C = A - D$

In other words, the optimum combined pre-suppression and suppression budget should be one that equals the averted damages less the net value change in resource values.

If satisfactory data is available for each of the four variables, we can derive the optimum level of fire protection expenditure. However, there is much difficulty in defining averted damages and the probability of fire outbreak depends on many factors, not the least of which include climatic-related ones. The concept of averted damages requires the analyst to predict exactly where, and to what extent damages would be incurred for the same for under two different scenarios—with and without suppression. As a result, this measure cannot be practically employed for this report and drives the need to adopt other, more extrapolative measures.

B. Recognizing other values-at-risk

It should be recognized that the forest protection function of Alberta Environment Protection is not designed to prevent and fight forest fires for the forest industry alone. The fire prevention and fighting activity has significant spillover of socio-economic aspects of other sectors. Beneficiaries include the oil and gas industry, tourism industry, farming communities, safety of residents in rural areas, and the environment. Although the economic values associated with these sectors cannot be readily derived for this analysis, they should be recognized at outset. For the purpose of this analysis, the value associated with the forest industry is the reference point.

The forest industry is third largest manufacturing sector in Alberta, after the oil/gas/petrochemical and the agriculture/food processing industry. The industry has experienced very rapid growth over the past 12-15 years with the total value of shipments increasing from less than $1 billion in 1986 to approximately $4 billion in 1999. The following statistics reinforce the significance of forestry in the Alberta economy.

- Gross domestic products (GDP): $2.5 billion.
- Value of shipments: $4 billion.
- Direct, indirect and induced employment: 36,000 jobs.
- Number of communities with significant dependence on forest industry: 40.

Recent estimates by KPMG also show that the forest industry, on average made the following contributions in 1997/98:

- Provincial corporate income tax: $166 million.
- Municipal taxes: $ 81 million.

- Stumpage and other protection charge: $ 90 million.

Furthermore, the forest resource provides the basis for the industry to expand further into value-added production. Erosion of this base will significantly jeopardize the growth potential of the forest industry as a whole, with subsequent impacts on the provincial economy.

C. Comparative analysis of forest protection expenditures

As discussed in section A, due to an inability to accurately value all of the necessary variables, a more extrapolative approach must be taken to assess the appropriate level of protection. The following three indicators directly linked to the forest industry and are described below:

- The proportion of forest protection expenditures relative to the value of forest industry shipments.
- The ratio of total forest protection expenditure to the net change in the economic value of the resource as a result of forest fires.
- The ratio of total forest protection expenditure to the volume of harvest.

Due to difficulty and subjectiveness in estimating the net value change, only numbers one and number three are adopted in the analysis that follows. These indicators are developed for Alberta as well as other five provinces for comparison purposes. It is through this across-the-board comparison that the appropriate level of fire expenditure can be gauged.

1. The proportion of forest protection expenditure relative to forest industry shipments

The proportion of forest protection expenditure relative to forest industry shipments is based on the argument that the forest protection expenditure should be proportional to the value of the forest industry. The value of the forest industry is represented by the value of shipments in this analysis. Exhibit XIV-1 shows the ratio of forest protection expenditures to the value of shipment in six provinces. These ratios were calculated using five year averages for both the forest protection expenditure and value of shipments for these provinces. The following observations are relevant:

- The ratio of total forest protection expenditure to the value of shipments varied significantly among the six provinces. Whereas Quebec, Ontario and B.C. had smaller ratios (from 0.0035 to 0.0057), the Prairie provinces had much higher ratios (from 0.024 in Alberta to 0.14 in Saskatchewan). The differences between the Prairie provinces and the other three provinces could be attributed to the difference in the climatic patterns.

- The ratio of Alberta's forest protection expenditure to total value of shipments was in line with that of Manitoba. The exceptional high ratio for Saskatchewan cannot be readily explained and this outlier was an issue identified by other studies.

- The three Prairie provinces had relatively larger pre-suppression expenditures than the other three provinces. However, among the Prairie provinces, Alberta has the lowest ratio of pre-suppression expenditure to value of shipments.

- While it is not entirely conclusive, it appears that a trade-off relationship does exist between pre-suppression and suppression expenditures.

Most forest protection expenditures in a high fire season are related to suppression activities for class E fires (200 ha and greater). Some of the fires in the 1998 season cost $0.5 to $1 million or more daily. Given this extreme cost, if pre-suppression expenditures could prevent a small proportion of fires reaching class E status, then the savings would be very significant. This relationship applies to Alberta and can be verified through research that tests the correlation between pre-suppression and suppression activities with there associated costs and benefits.

The ratio analysis suggests that the pre-suppression budget of Alberta was proportionally smaller than other Prairie provinces and as a result, has paid a higher price in fighting actual fires. Here may lie the argument for Alberta to have a larger pre-suppression budget. These observations also held on a historical basis for the three Prairie provinces as shown in Exhibit XIV-2.

Exhibit XIV-1
Forest protection expenditure and value of forest industry shipments (X 10^{-3})

Ratio	Quebec	Ontario	Manitoba	Sask.	Alberta	BC
Total budget to value of shipments	3.47	5.38	29.25	138.59	24.37	5.77
Pre-suppression to value of shipments	2.71	3.24	14.59	70.89	9.56	2.52
Suppression to value of shipments	76.00	2.14	14.66	67.70	14.80	3.25

Exhibit XIV-2
Proportion of forest protection expenditures relative to the value of shipments for the three prairie provinces, 1990-1998 (X 10^{-2})

	Pre-suppression exp./ value of shipments			Suppression exp./ value of shipments		
Year	Manitoba	Sask.	Alberta	Manitoba	Sask.	Alberta
1990	1.4	4.5	0.7	2.0	8.1	2.6
1991	1.7	7.0	1.2	2.1	8.0	1.3
1992	1.4	5.4	0.6	1.1	1.4	1.5
1993	1.4	4.5	1.3	1.0	6.7	1.2
1994	1.4	3.6	1.0	1.3	0.9	0.9
1995	1.4	3.4	1.0	3.8	11.9	1.5
1996	1.5	3.2	1.0	1.2	0.8	0.2
1997	1.5	3.3	1.0	1.0	3.2	0.0
1998	1.4	3.3	1.0	2.3	7.7	5.4
9 year averag	1.5	4.0	1.0	1.8	5.3	1.6

2. Ratio analysis of total forest protection expenditure to volume of harvest

The ratio of total forest protection expenditure to volume of harvest relates the level of forest protection expenditure to the level of timber harvest under various tenures in six provinces. Exhibit XIV-3 shows a comparison of the relationships.

The Prairie provinces have much higher ratios of fire protection expenditure to total volume of harvest. This phenomenon can be explained by the differences in the fire ecology and climate between the Prairie province and BC/Quebec/Ontario. Thus, for the purpose of this report, a comparison that focuses on the Prairie provinces appears to be more appropriate. With this understanding, Alberta was at the low

end of the spectrum in terms of the pre-suppression expenditure/m^3 at $1.70/$m^3$ compared to $5.42/$m^3$ for Saskatchewan and $5.05/$m^3$ for Manitoba. A 14 year average provides another indication that the pre-suppression in Alberta is low and that there is a need to increase pre-suppression expenditures to a more appropriate level. This observation is also supported by evidence from reviewing the pre-suppression expenditure per hectare of timber harvested under various other tenures (Exhibit XIV-4).

Exhibit XIV-3
Forest protection expenditure and volume of harvest

	Quebec	Ontario	Manitoba	Sask.	Alberta	BC
Volume harvested (1,000m^3)	35,586	27,115	1,708	3,606	13,504	79,444
Pre-suppression exp./m^3	0.81	1.24	4.75	5.31	1.70	0.51
Suppression exp./m^3	0.27	1.03	8.93	8.43	2.30	0.68
Total exp./m^3	1.08	2.27	13.68	13.75	4.00	1.18

On a historical basis (Exhibit XIV-5), it is interesting to note that the ratios of pre-suppression expenditures per cubic metre of timber harvested in the three Prairie provinces remain relatively steady.

Exhibit XIV-4
Pre-suppression expenditure/hectare of timber harvested

	Quebec	Ontario	Manitoba	Sask.	Alberta	BC
Pre-suppression/hectare of timber harvested	99.30	188.98	744.27	1194.00	481.43	199.71

Exhibit XIV-5
Pre-suppression expenditure/m^3 of timber harvested ($/m)

Year	AB	Sask	Man
1985	3.04	2.98	3.70
1986	1.73	2.94	4.61
1987	1.68	2.86	4.08
1988	1.37	3.14	3.85
1989	1.56	3.34	3.82
1990	1.11	4.32	5.51
1991	1.85	4.37	6.66
1992	0.86	4.74	5.07
1993	2.36	3.36	5.36
1994	1.73	4.43	5.40
1995	1.74	4.76	4.98
1996	1.73	5.58	6.11
1997	1.77	5.73	5.95
1998	1.65	5.36	5.64

D. Funding the forest protection program—who should pay

In addition to an analysis of the appropriate level of funding for the forest protection budget in Alberta, the question arises of who should pay. A number of approaches can be applied to the funding of the program ranging from full government funding to full user pay in the form of protection charges and/or downloading of responsibilities.

In assessing this issue, a number of considerations must be evaluated including:

- Who are the beneficiaries of the program?
- What criteria are needed to allocate costs?
- What is the practice in other jurisdictions?

1. Beneficiaries

Beneficiaries of forest protection are wide ranging. The following is a list of primary beneficiaries and how benefits of forest protection accrue to them:

- General public—safety, environmental benefits, existential value and possible future use.
- Provincial government—representing the "owners" of the Crown forest and owners of infrastructure in the forest (i.e. parks, transportation infrastructure, special areas, etc.).
- Provincial Treasury—which receives stumpage, taxes and fees from users.
- Government of Canada—responsible for Indian Reserves, National Parks, receiving protection services through fire control agreements.
- Municipal Districts and Counties—with responsibility under legislation for fire suppression in their jurisdictions, and receiving some protection services through fire control agreements.
- Forest industry—with FMAs and other tenure as well as plant infrastructure and equipment at risk.
- Oil and gas, power and communications industries—with infrastructure at risk.
- First Nations—through on and off-reserve assets and uses of the forest, including also cultural sites.
- Private and leased land holders—forest land owners and lease tenure holders including cottages, commercial tourism facilities and ranches.
- Recreational users—hunters, fisherman, park users (all fee paying and non-fee users) canoeists, hikers, photographers, etc.

It is appropriate to assume that the forest protection system should be funded to some extent by these beneficiaries. The allocation of the funding amongst these beneficiaries is the key question—particularly if some are required to pay their share for the first time.

2. Criteria for cost allocation

If fire management costs in Alberta are to be allocated in a different manner than the current system, there are a number of criteria that would need to be thoroughly developed. They would include:

- Liability.
- Public interest.
- Administrative feasibility.
- Ownership.
- Service cost.
- Relative benefit.
- Ability to pay.

Following are some comments on these criteria and how they might be developed.

1. Alberta does have the authority to collect costs from those who cause fires, provided that the evidence is sound and that the province chooses to pursue this cost collection. Little revenue can be expected from this source for the following reasons:

    - It is difficult to identify the people responsible and obtain proof.
    - The ability to pay (except for corporations) is problematic in light of huge expenditures for fire suppression.
    - Man-caused fires represent only 40% of all fires occurring in the province.

    A case may be made for fees to be levied on forest users (groups) who are identified as causing some fires each year (i.e. park users, fishermen, hunters, and other recreational users of crown land), however, the collection process may be administratively unwieldy. Most groups would present the case that they already pay a user fee to the government, through permits, fees and taxes.

2. Public safety is the key priority of the Alberta Forest Protection Program. Public safety is also considered to be a primary responsibility of government, and historically, people have not been expected to pay to protect themselves from natural events in the course of normal activities.

   There are other benefits to the public of protecting forests including environmental quality; existential value and expecting future use of the forest. These benefits impact all Albertans equally.

   There are however specific beneficiaries that rely on protection for their economic health such as the Forest Industry. The industry will present the case that they already pay the bulk of these costs through holding and protection charges and royalties.

3. Any distribution of costs has administrative constraints, from identifying the individuals or groups to being able to obtain the payments in a cost-effective manner. This issue is particularly problematic if recreational users are considered.

4. A case can be made for landowners to pay a share of forest protection costs which reflects the area of forested land they own. This allotment would include private, provincial government, federal government, municipalities, Oil & Gas, utilities and other industries. The challenge is to assess what percentage of costs are appropriate—40% - 50% - 70%?

5. Some areas of the province have higher protection costs than others, and the incidence of fire varies significantly. If beneficiaries are to pay the user fees, they would have to be stratified to reflect these differences.

6. An approach would have to be developed to calculate relative benefits before contribution rates are established and accepted. There are three variables:

   - Assets at risk.
   - Income at risk.
   - User values-at-risk.

   When all is evaluated, the data will suggest that the economic benefits of forest protection to the forestry sector outweighs any other, particularly

recreational users. This line of reasoning also implies that the forest sector should be the largest contributor, which they are now.

7. The ability to pay is a limiting factor for many beneficiaries.

   If there is the political will to substantially alter "who pays" for forest protection in Alberta, these seven criteria would have to be developed and analyzed to ensure fairness, public and corporate acceptance, and an integrated approach to implementation. There are considerable hurdles to overcome. An example is the question of how do you achieve a balance between the government of Alberta's responsibility for public safety against the economic benefits of protection for the forest industry?

   If an increase in the "user pay" approach is taken, there would be a demand from the users to have a say in what they are paying for, including:

   - Level of service.
   - Operational priorities.
   - Overhead costs of delivery.
   - Split of funding between preparedness and suppression.
   - Opportunities for efficiencies.
   - Forest practices.
   - Nature of the delivery agency—i.e. government or private sector.

   Going down this path would seriously complicate the role of the LFS as the forest protection agency of the province by introducing other agendas to the mix. Currently the LFS is the sole provider of services in the Forest Protection Area and this prevents complicated inter-organizational communications protocols from being required.

3. Other jurisdictions

Quebec has a unique system—all landowners (over 800 hectares) or long term licensees are involved in setting the budget and paying a per hectare charge. Fifty

percent of the budget is borne by the Government of Quebec. However, the situation, organizationally and geographically, in Quebec is different from Alberta. There are a large proportion of private forest landowners and the forest protection system is delivered by a separate corporation made up of the key landowners, government and licensees. It may serve as an example worth further investigation for its positive attributes.

Other provinces across Canada have arrangements similar to that of Alberta. Forest protection is funded primarily from general revenues and from protection charges levied against the forest industry. Saskatchewan had plans to decrease the level of funding from government and increase the level of funding from all forest users, however after three years, were unable or unwilling to institute these changes. The primary issue that served as a barrier to this change was the ability to pay and industry arguments that protection serves the public primarily and industry second.

E. Conclusions

The current level of funding for the Forest Protection Program in Alberta is at a relatively lower level than other prairie provinces on comparative basis, and is at a relatively higher level than B.C., Ontario and Quebec. Given similarities in forest types, climate and distribution of forest ownership, it is most reasonable to compare Alberta to the other prairie provinces.

The approach to funding the Forest Protection Program in Alberta is similar to other jurisdictions across Canada. The government and forest industry pay for forest protection. Opportunities in Saskatchewan to have other forest users pay part of the program are no longer being pursued. Increasing fees for forest protection in other jurisdictions is not being considered.

F. Recommendations

33. The government of Alberta should increase the level of base funding for forest protection recognizing that the current level is generally insufficient for funding typical fire season costs and that frequent requests for funding are remitted to the Treasury Board each year. An increase in the base budget will not, by itself, add to total forest protection expenditures overall and in fact may decrease suppression costs by supporting a higher level of pre-suppression. There is a need for and benefits from of an increased level of pre-suppression

activity given this trend toward longer fire seasons (and therefore increased expenditures) across Canada.

34. Continue funding the Forest Protection Program from the current mix of revenues—forest industry royalties (through the Emergency Fund), forest protection charges, and if there is a shortfall, general revenues (i.e. taxes). Although changes were considered to the level of protection fees charged and the scope of industries required to pay the fee, no change is recommended at this time. However, consideration should be given to reducing protection charges where companies take direct actions aimed at reducing the risk of loss and improving the speed and effectiveness of response.

XV

Incorporating Fire In Landscape Management

In this chapter, issues that address the manner in which fire is incorporated into a provincial landscape planning framework are analyzed. The chapter discusses a broad spectrum view of planning as well as the ecological theory that can provide a basis to analyze how well current planning methodologies and practices align with landscape processes such as fire. The topics outlined for discussion in this chapter are as follows:

- Overview of planning in Alberta.
- Landscape management planning principles applicable to fire.
- Forest management planning and fire.

Incorporating fire management into Alberta's landscape management framework is critical. Ultimately, the management of fire to protect valuable resources and key forest values can not be accomplished through fire suppression alone. Wildfire will always be an integral part of Alberta's forests requiring that an integrated approach to landscape management and forest protection be practiced.

A. Overview of planning in Alberta

Alberta has put into place a hierarchical planning framework for land and resource management throughout the province. In this section, we briefly describe the nature of this planning system to provide a context for the discussion of landscape management principles and the opportunity to incorporate fire and forest management in Alberta.

Alberta has attempted to employ an integrated resource management framework to provide broad direction for landscape planning and land use decision making at a regional level. In the past, this has been accomplished through the development of regional and sub-regional integrated resource management plans that address land use priorities and that provide direction for various resource management plans to be prepared. Integrated

resource management plans are now being replaced by a framework consisting of policy statements, land use plans and other forms of direction for the use of landscapes within Alberta.

Under the umbrella of an integrated resource management framework are resource management plans that address the management and use of the various resources associated with Alberta's landscape. The most common and well developed resource plan is the Detailed Forest Management Plan. The Detailed Forest Management Plan provides an essential link between regional or landscape level direction from an integrated resource management framework to the management of forests for wood fibre and other forest resources.

The Detailed Forest Management Plan operates on a 20-year planning period and utilizes a planning horizon of between 140 and 200 years. The planning period reflects the term associated with the major types of forest tenure systems in the province and the planning timeframe is intended to represent two rotations of the commercial tree species being managed in the planning area.

Forest management plans have developed significantly over the past 10 to 15 years in terms of scope and detail. Many of these plans today address integrated resource management issues and in some respects, function as an integrated resource management plan.

Under the more strategic and long range forest management plan are operational plans nested within the planning system. Exhibit XV-1 shows the hierarchy of these plans. Under the detailed forest management plan are the following:

- General Development Plan—a plan depicting a development of wood fibre resources over a period of at least five years. The plan is used as the basis for planning the development of a network of roads and for developing annual operating plans in an orderly and logical fashion.

- Compartment Harvest Plans—where an area is managed on a compartment basis, compartment harvest plans will add detail to general development plans by indicating the stands and blocks within each compartment that will be developed to provide additional information for road construction, block planning and silvicultural activities.

- Annual Operating Plans—annual Operating Plans guide detailed logging operations in each year by showing where cutblocks are located, how cutblocks are configured, and how operations within cutblocks will be

managed (i.e. in-block roads, skid trails, etc.). Annual operating plans require approval before any physical operations are permitted.

- Performance monitoring—while not a level of planning, performance monitoring is included in the planning framework as the continual comparison of planned activities to actuals help to continually improve planning and operations.

Exhibit XV-1
Alberta's planning framework

B. Landscape management planning principles applicable to fire

1. Landscapes and landscape ecology—tools for understanding and managing fire

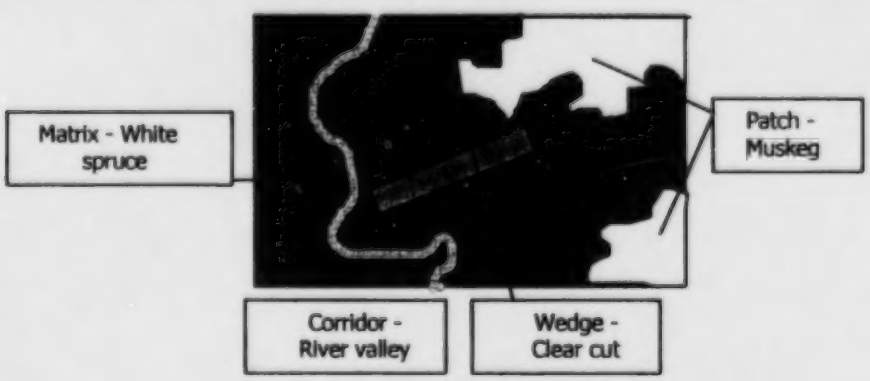
From the perspective of a landscape ecologist, there exists a hierarchy of scales on the planet Earth—starting with continents at the macro end of the spectrum, which are then sub-divided into regions, regions into landscapes and landscapes into

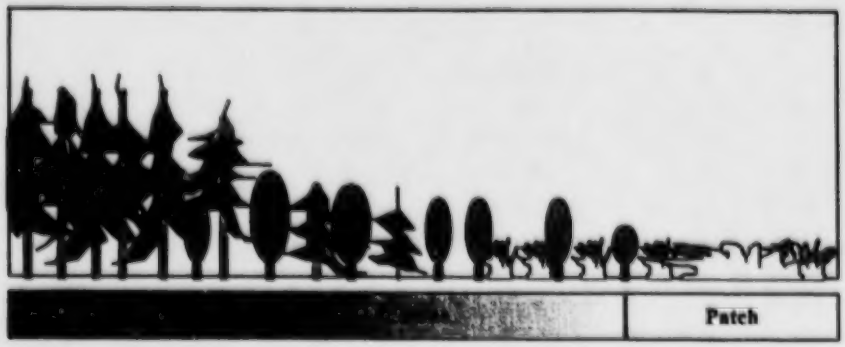
ecosystems or land-uses. This hierarchy can then carry on to a more resolute scale—from communities right through to cellular levels when considering genetic diversity.

A landscape, being the commonly used management unit in landscape ecology, is comprised of a repeating formation of ecosystems and extends over space until that recurring set of ecosystems significantly changes. The boundary between landscapes is often delineated by the overlapping boundaries of geomorphic processes and disturbance regimes. Soil types, flood and fire regimes are examples of processes that occur within, and subsequently define, a landscape. Very generally, the scale of landscapes range from less than a kilometer squared to many thousands of square kilometers—depending on the magnitude and extent of the natural processes defining the landscape.

Landscapes with a healthy level of diversity contain a mosaic of ecosystems and different landscape elements. A landscape is broadly defined by its matrix—or the spatially contiguous backdrop in which a number of elements are embedded such as corridors, patches, ecotones and wedges as depicted in Exhibit XV-2. It is the diversity and distribution of these landscape elements that control the flow of energy within and across the landscape. Each of these metrics perform a unique function on the landscape and there are species and landscape processes that rely on the relative presence and positioning of these metrics to support their sustainability.

Exhibit XV-2
Landscape elements - aerial and cross section perspectives





From this perspective, examples of types of energy include flowing water, wind, gravity and fire, as well as migration routes for birds and animals. Corridors facilitate the flow of energy by providing a path of least resistance for energy through such pathways as such as valleys, river beds or alpine meadows to name a few. However, in some cases, a corridor may represent a barrier to energy flow as a river (corridor) would prevent a fire (energy) from advancing. Patches are formed by a variety of landscape features ranging from patterns of repeating species composition to distinct islands of rare plants or human settlements. Wedges are a specific type of man-made patch that provide a slightly different role in that their primary purpose is to create a barrier to energy flows, such as fire, in the surrounding matrix. And finally, ecotones are the boundaries between patches or corridors and the matrix in which they are embedded. There are also ecotones between adjacent landscape-types. Some ecotones represent areas of great diversity as they meld the species content of two different landscape elements and these types of ecotones are often wide and gradual. Alternatively, some ecotones are abrupt and are most often the result of an increased disturbance regime, such as human land-use practices or fire. Overall, it is in a healthy distribution of these elements throughout a landscape that support biodiversity and sustainability—which has important implications for landscape management practices that aim to achieve these objectives.

It is appropriate to apply the principles of landscape ecology to an analysis of the role of fire on the landscape as the discipline views the world at the same scale at which fire operates—much in the same manner that it is appropriate to use a microscope to study and analyze bacteria. Through the applied use of landscape ecology, it is possible to better understand fire and how it should be managed for–which has been the basis of considerable research and development in the area of forest management.

2. Fire in forested landscapes

Landscape ecology uses the landscape as a basic management unit and studies the flow of energy between, within and across these units. Fire is an example of a type of energy flow that operates within and across landscapes. At the landscape-level, fire behaves according to the principle of simple physics, moving across the landscape through paths of equal or less resistance and it is on this premise that landscape ecology becomes an effective tool for understanding fire behaviour and its impact on the forested landscape.

Fire is a natural process within Alberta's forests and studies have shown that the boreal forest and the species within it have evolved their regenerative and reproductive processes to respond positively to fire occurrence—including coniferous, deciduous and understory species. The presence of fire has fluctuated significantly over time and has been measured over decades (using age-class distribution), centuries (using stand origin maps) and even millennia (using lake charcoal deposits). Overall, researchers have found that fire has a dynamic behaviour that varies, both in distribution and intensity, over time and space and plays a critical role in maintaining a sustainable forest.

3. Natural processes and human interaction

Land-use patterns and other human activities are superimposed on all landscape processes including fire. The extent to which human activities and management strategies influence or alter the underlying natural processes is variable depending on the intensity and duration of those human activities.

a) Fire suppression

Current forest management policies and practices encourage and support the suppression of all fire in Alberta's forests. Fire suppression has denied the forest of its renewal processes—creating a shift in the age-class distribution towards more mature stands. These mature stands are characterized by accumulating layers of dead vegetative matter which would have otherwise been cleared away by rapid, relatively low temperature surface fires. Accumulating fuel loads now provide opportunity for fires to build greater momentum and intensity, often allowing the fire to crown. There are a number of hypotheses on the impacts of a crown fire to biodiversity ranging from no impact to total devastation. However, one of the most immediate impacts of crown fires are their propensity to burn over much greater areas—destroying both current and future timber supply.

Complete suppression has never been achieved in Alberta, mostly as a result of the immense area of land where fire occurs naturally. However, in the past, complete suppression was unnecessary as there remained a greater proportion of unallocated land—thus, in the event that productive land was eliminated, other portions of land could be assigned and utilized accordingly. Excess land provided greater flexibility for landscape processes and as a result, the landscape (and the industries that depended on it) could be much more forgiving of large fire events.

b) Increased land use pressure

In more recent times, the flexibility of landscapes to absorb disturbances has been eroded as a result of growing land use pressure. The growth in land-based industries such as forestry, oil and gas and agriculture have largely contributed to the consumption of Alberta's historically unallocated land base. At the same time, growing populations have resulted in urban sprawl, increased pressure for recreation areas and, overall, increased resource consumption which have also served as a driver to reduce the flexibility of the landscape to its own natural processes.

The evolution of the intensity and complexity of land use activity has paved the road to a landscape system that can no longer operate as it once did. There is no room in the system for large losses of productive land to fire or any other process or conflicting land use activity—driving the need for a new approach to landscape management. Section C of this chapter will provide a high-level discussion of the underlying theories and principles of this new approach to landscape management.

c) Traditional harvesting and reforestation patterns

Harvesting and reforestation patterns have created large matrices of even-aged stands which are equally, if not more attractive to massive fire events. These even-aged matrices provide a contiguous volume of fuel that often carries on for great distances in many directions. Historically, the forest would have more patchy and uneven characteristics, making it more difficult for fire to continue on uninterrupted for great distances. Natural barriers, such as a change in fuel type or density, would have often provided sufficient impetus to bring the fire to a close. Additionally, fire history studies suggest that fires were both more frequent and less intense, making the imprint of annual fires less significant on a regional basis. On this basis, it can be seen that the challenge for today's land managers is to find ways to best emulate this

discontinuity in fuel loads and fire intensity to protect the forest from the devastating fire events of recent years.

c) Traditional harvesting and reforestation patterns

Superimposed on the previously discussed land management practices, there remains yet another element management practice that has exacerbated the effects of an altered fire regime—formalized and discrete Forest Management Areas. Current industry practice in Alberta is to assign discrete portions of the landbase to specific companies to manage for timber production. Each company has a slightly different approach to forest management planning but all have applied the same fire suppression, harvesting and reforestation techniques that have contributed to an altered fire regime across the boreal landscape. Each unit has created its own homogeneity that flows into neighboring units of homogeneity—thereby largely eliminating the dynamic mosaic pattern that once weaved its way across the landscape. The net result of regionalized landscape management is a significant homogenization in the relative distribution, density and consistency of fuel types across the landscape—providing ample opportunity for fire to sweep its way across large portions of individual FMAs.

C. Merging forest management practices with landscape management

Fire is a natural component of the boreal forest and continues to operate at the landscape level as it has for millennia. However, current forest management practices have amplified the impact of fire, both on the forest and the land use, by decreasing the level of diversity over the landscape. FMA holders must work together to marry their forest management practices to re-introduce the natural barriers and protection from wide-spread fire events. Together the forest industry has contributed to this challenge and it is together that they will find the solution. The following sections discuss how the principles of landscape ecology can be applied to forest management planning to recreate a natural resistance to large scale fires which can no longer be absorbed by the landscape and its users.

1. Fuel management

Alberta needs to place greater emphasis on fuel management as a key aspect of fire management. In the current model, planned AAC and spatially discrete land allocations are not in any way compatible with a natural fire regime, in fact, they are

mutually exclusive. Large fires create bottle-necks in the age-class distribution which is especially problematic for small FMA holders. There are a number of land management approaches that could be implemented to aid the integration of fire into modern forest management practices.

Managing fuel loads need to be incorporated into forest/landscape management planning as they will provide a proactive means of preventing or reducing the intensity of wildfires. The concept of 'cooling the forest' is tied closely to fuel management and in many cases, these types of activities are already being applied. However, these techniques need to be re-designed and applied to specifically achieve a reduction in fuel accumulation. In a larger context, these techniques should also be applied as a means to protect communities and other critical infrastructure. Examples of these fuel management techniques are listed below and apply most directly to the management of commercial forests, but many can be applied to non-productive forests or urban areas as well.

a) Site preparation

- Herbicide application to reduce grass fuel loading while promoting seedling establishment.
- Prescribed fire to reduce slash and grass fuel loading.
- Mechanical site preparation such as furrowing to reduce the spread of surface fires by creating small discontinuities in surface fuels.

b) Regeneration

- Where appropriate, change dominant forest cover from a highly flammable coniferous species to a less flammable deciduous species (i.e. mixed wood stands).
- Apply treatments, such as fertilization, to encourage tree growth and rapid crown closure to out-compete ground vegetation cover for resources—thereby reducing surface fuel accumulation.

c) Stand management

- Reduce potential for crown fire development by removing unnecessary ladder fuels—i.e. pruning lower branches to increase crown-base height.

- Thin crown fuel loads of semi-mature and mature stands—reducing the potential for sustained crowning.

- Reduce dead and down fuel loads (especially fine fuels) in mature stands to reduce the intensity of a surface fire and subsequently, reduce the opportunity for fires to crown.

d) Harvest

- Orient cutblocks to serve as barriers to the spread of large fires.

- Where ecologically appropriate, emulate large disturbance on the landscape by using larger, irregularly shaped cutblocks with residual islands to serve as a fire barricade.

- Include non-productive stands and buffers in management plans to prevent them from contributing to large fires.

- Use harvest systems that minimize the amount and distribution of slash over the cutblock.

- Apply techniques such as salvage thinning to reduce stand density and vertical fuel continuity.

e) Road lay-out design

- Develop a comprehensive access management plan to optimize the use of roadways in the following ways:

- Integrate forestry roads with both existing and proposed linear clearings (i.e. oil and gas roads, pipelines, powerlines, etc.), forest cover type and topographic features in order to maximize fuel break effectiveness.

- Locating roads to minimize fire suppression response time by ground.

- Locating roads to provide easy access to natural or man-made water sources.

- Planning for roads to be used as anchor points during indirect attack on large fires.

- Positioning roads to maximize their utility as a fire barrier.

- Restricting human access to limit the risk of human-caused ignition.

2. Move towards a model of regional wood supply

Move to a regional land allocation model that would allow for large-scale disturbances in the following manner:

- Integration of forest management planning on a larger landbase would ensure a consistent approach and priority ranking of values with neighboring FMAs.

- Regional allocation of timber would be more forgiving in the event of a large-scale disturbance and would decrease risk levels for individual companies, especially small operators. Probability of sustaining AAC would be significantly increased if timber allocation were not associated with a discrete portion of the landbase.

3. Apply adaptive management techniques to provide a continuous improvement mechanism in forest management planning

Adaptive management refers to a management process that relies on feedback and monitoring mechanisms to provide a constant evaluation of the success of management initiatives which can play a key role in forest management planning. Results from feedback loops provide a means to quantify change which enables the effectiveness of initiative to be measured comparatively to previous conditions and new objectives.

Adaptive management techniques allow a range of values to be encorporated into management objectives such as timber or biodiversity. More importantly, adaptive management allows certain values to be maximized while at the same time, constrained by other values. For example, maximize harvestable timber volumes constrained by the distribution of large landscape disturbances. The effectiveness of this technique is directly related to the monitoring and feedback mechanisms put in place to measure and quantify various aspects of the range of values being managed for. This process has already been embraced by a small group of forest companies and needs to be adopted by all to test the resiliency of their forest management plans.

4. Risk analysis

There is a definite need to encorporate risk analysis into formal landscape planning models, in particular, Forest Management Plans. Proactive management reduces risk from uncertain circumstances by building a 'safety net'. This safety net takes the form of increased resilience and flexibility in the landscape systems to absorb the impacts of large-scale disturbances. However, in order for the safety net to be established, land managers need to understand what factors are contributing to and what they can do to mitigate the risks to various values they manage for—including timber supply.

D. The evolution of forest management planning

Modern land management practices commonly focus on the ecosystem or land-use level of the scale—this approach also holds true for forestry. For industries based on resource extraction, the approach logically places emphasis on maximizing the output of that resource by managing the system that provides it—for salmon we manage streams and estuaries; for timber we manage forests. However, issues begin to arise when the management structures for those land-use patterns do not align with the scale at which the resource must effectively be managed for—such is the case with current forest management practice and fire.

Ultimately, we have to keep fire on the landscape or the likely result will be a collapse of ecological systems and the forest industry alike. Resolution of the gap between management planning and fire will be found in adopting an approach that allows fire to occur where it can and concentrate efforts on preventing it from being everywhere. Prevention comes in the form of proactive management planning that anticipates fire on the landscape and develops harvest systems that can tolerate and, ideally, absorb its presence in a sustainable manner.

There are four key concepts critical to the success of evolving forest management planning to a higher scale on the landscape. These concepts will have to be embraced and accepted by forest managers in order to effectively build fire prevention into their management plans and are as follows:

1. Put an end to the myth of a fully regulated forest

Many aspects of current forest management planning techniques are based on the principles of a fully-regulated forest—Europe has achieved this plateau many decades ago. A key component of the fully-regulated forest is the complete

exclusion of fire from the landscape which Europeans have also achieved. The reality for Canadian forests is that fire will never be excluded from the forest due to the great expanse of forested landscape in this country. The objective of achieving a fully-regulated forest is unobtainable in a pyrogenic forest.

Furthermore, Canadian foresters actively manage for a range of values other than timber such as biodiversity, recreation and wildlife, which also is not consistent with the objective of a fully-regulated forest. Fully-regulated forests exclude variability and the resulting diversity which supports many of these alternative values. However, foresters still continue to manage on this basis by not incorporating elements, such as fire, into their management plans.

2. The growing role of education

All land managers, both current and future, need to have a greater understanding about fire as part of the landscape. Forestry programs do not do not adequately address fire and how to manage for it. More importantly, land managers are not being trained with the skills needed to plan for uncertainty or to comprehend and conduct risk analyses. These concepts, in particular, play a critical role in successfully planning for fire.

Due to the limitations of formal education programs, there is a growing need for informal education systems and processes. New ideas and concepts, but more importantly, new tools and skills need to be fed back into the forest industry to enable it to benefit from the most recent advancements in landscape planning and management. Seminars, conferences, continuing education programs, partnerships, publications, working groups and joint committees all provide an opportunity to upgrade and maintain skill levels in the forest industry.

3. Start planning for uncertainty and risk

Uncertainty plays a role in all industries and in all business planning. The key to overcoming the potentially negative impacts of uncertainty is careful assessment of the factors contributing to the uncertainty and the development of processes to counteract those potentially hazardous factors. The next step to devising management strategies that account for uncertainty is to develop a methodology to effectively analyze the risk of different management strategies. Once a risk analysis has been completed, a land manager can effectively decide which management strategies must be implemented to mitigate the risk and reduce the probability of a negative impact from uncertain outcomes.

Risk management needs to be encorporated into forest management planning. Forest planners that ignore fire in their Forest Management Plans do not have the means to assess the risk of fire or measure fire/fuel management initiatives. Therefore, an important first step in improving fire management capabilities is including the variability and uncertainty of fire into all forest management planning.

4. Improve technology transfer from the scientific community

Researchers have been developing a growing pool of knowledge in areas such as fire behaviour. However, there is opportunity for growth in technology transfer processes and programs which will allow practitioners to apply this knowledge in the field.

Researchers can work to improve this process by communicating their findings in a user-friendly manner such as guidebooks, training courses and modules. These initiatives put the knowledge in the hands of the forest managers in a format that can be easily applied.

Finally, one of the most important support mechanisms that the scientific community can offer to improving industry capabilities is to 'ask the right questions' in their research. Research that keeps industry applicability in focus can more easily be transferred to industry practitioners. Research results need to make the connection to industry application early in their development, which can provide a two-fold benefit: industry can adopt new research more quickly and as a result of their improved understanding, researchers benefit from a renewed enthusiasm in their research areas which is often followed by improved sponsorship and funding.

E. Conclusions

There are currently strategies and tools available to forest managers to more effectively integrate fire management with forest management at various scales. Fire can be addressed at the landscape level, detailed forest management planning level, and operational planning levels. While the tools exist, the two perspectives of fire management and forest management have not yet been reconciled. Given the continuous and ever increasing demands being placed on Alberta's forest resources and forested land base, and given that our economy and communities in Alberta are very much linked to our forests it becomes more and more critical that the two perspectives come together.

A paradigm shift is required. It will not suffice to manage for fire on the one hand and for landscape values on the other. A top down approach to planning that includes fire must

be strengthened and must form the essential backbone of forest management and must ultimately drive the type of forest protection program required in Alberta.

F. Recommendations

35. Clear direction for the integration of fire into forest resource management and landscape level planning must be provided and must drive the combination of the practices of fire management and forest protection in Alberta. This direction should be provided in the form of a strategic plan or a set of policies and a directional framework that allows for the amalgamation of fire and landscape management. The new Ecological Landscape Division is in an excellent position to meet these needs.

36. Actively manage for fire in Alberta's forests. LFS should incorporate landscape management into forest management and operational planning by:

    - Sequencing harvests based on susceptibility of timber to fire (not necessarily sequencing harvest of oldest timber first).
    - Modifying existing operational ground rules to reflect regional fuel management needs with the use of landscape management tools.
    - Managing the non-commercial landbase as well as the commercially productive landbase to reduce fire susceptibility.
    - Reducing the partitioning of the landscape through industry partnering (i.e. road sharing agreements, coordination of right of way development, timber harvesting activities and improving the integration of operational plans prior to approval).

37. Incorporate fuel management into forest management and operational planning by:

    - Maintaining an inventory of fuel types, amounts and distribution in high valued areas that are susceptible to fire (identified internally or FMA holders).
    - Projecting the effects of operations on the fuel characteristics.

- Reducing the amount of fine fuels produced from operations such as logging, thinning, right of way construction and other industrial activities.

XVI

Organization And Structure

Part I of the Alberta Fire Review addressed the structure of the LFS fire management organization and made some recommendations regarding the definition of roles, dedication of staff and accountability. Further analysis of the structure of the current organization have raised issues of its ability to meet future demands for protection in Alberta.

A. Issues with the current organization and structure

There were a number of changes made to the organization and structure of the Forest Protection Program at the end of the 1998 fire season; however concern still existed with the program and the relationship between the Forest Protection Division and the regions. The primary concern was related to the creation of 10 "quasi-regional" fire centres and the lack of clear lines of accountability and responsibility.

The specific issues that continue to affect the forest protection program are outlined as follows:

1. A diffuse command and control structure

The command and control structure within pre-suppression and suppression systems is complex and crosses a number of organizational units within the LFS including:

- Four forest regions (with fire liaison and/or support responsibilities).
- Ten "quasi-regional" co-ordination centres with responsibility for initial attack dispatch (but not responsible for sustained action beyond support and communication with Provincial Headquarters).
- Seventeen forest areas—all responsible for and involved in directing, delivering and supporting on-site fire control activities.

- One central control function at the Provincial Forest Fire Centre, responsible for airtanker dispatch and overall support functions.

2. Unclear accountability and responsibility

Within this diffuse command and control structure lies uncertainty regarding individual and team responsibility for various functions and activities. Forest area managers continue to report to two superiors—Fire Centre Managers and the Regional Director.

3. Difficulty in working with area and regional boundaries

Given that accountability, responsibility and team function within the fire program are not always well understood (or not understood in the same way) by all field practitioners and managers, the existence of various administrative boundaries (region, fire zone, forest area) can lead to some confusion and difficulty during peak fire times. The command and control framework is often by-passed.

4. Insufficient community and industry contact

The level of community and industry contact has not been sufficient to build productive partnerships aimed at increasing resource availability and enhancing crew training and development. This is particularly true for Aboriginal fire crews and communities who play a key role in forest protection. Contract liaison positions have been very successful and productive and clearly point to the need for more of this type of function within the LFS.

B. The need for an increased emphasis on forest protection

Alberta's forest industry has more than doubled over the past 10 years and has become a key driver in the provincial economy. In addition, non timber related activity in our forests, through the energy and tourism industries has increased greatly as well. Communities have grown rapidly within the forested areas and are rightfully concerned about the protection offered to their homes, communities and livelihoods. Given that Alberta has become increasingly dependant on the forest, it is clear that renewed or increased emphasis on forest protection is needed.

In terms of direct contributions to the economy, the yearly GDP supported by the forests of Alberta is estimated at roughly $2.5 billion dollars. This figure is an estimate of the

primary forest industry in the province. In addition to this number are many non-financial forest values such as recreation, wildlife, watershed, aesthetics and other that add value to the worth of our forests. Although an argument supporting increased forest protection can be made based solely on the value of timber from Alberta's forests, there are clearly many other values from the forest that warrant protection:

- The energy sector has greatly expanded exploration and development of oil, gas and tar sands resources within forested areas.
- Wildfire can threaten facilities and disrupt production resulting in economic losses.
- Forest based communities are growing rapidly.
- Alberta has 321 communities located in the Forest Protection Area, all of which face the treat of wildfire.
- Cities and towns such as High Level, Peace River, Whitecourt, Edson, Hinton, Slave Lake and many others are dependent on forestry, energy and tourism industry activity for their economic well being. Wildfire threatens the economic base of these communities.

C. Current organization and structure

The pre-1992 LFS forest protection organization displayed some of the elements of the current organizational structure. It was designed to take advantage of forest officers and foresters employed in general field capacities to organize and manage summer wildfires. A relatively small number of field and headquarters staff were dedicated to the fire program for the entire year. Regional and district forestry staff were assigned to the fire program in the summer and returned to other necessary forestry duties during the "off season" or during times of lower hazard and activity levels.

The current LFS fire management organization has been significantly flattened, however, in the wake of overall changes in the department and has placed more emphasis on Area management. Forest Areas have been reduced to 17 from the original 43 districts. Support for the Forest Areas in terms of forest protection is provided from the Provincial Headquarters and 10 quasi-regional locations. Some year - round dedicated staff have now been assigned to 10 "fire centres" to carry out the fire program in their respective areas of influence and to provide programming/training in the "off season".

Considering the significance of forest resources to Albertans and assessing the issues with the current organization and structure, there is reason to believe that the forest protection organization could serve the people of Alberta better. The following sections present some analysis on how the organization and structure might be modified to help enhance the delivery of the forest protection program for Alberta.

D. Principles and attributes of an effective forest protection organization

An organization established to meet the forest protection needs and expectations of key stakeholders and the general public should be based on a number of core principles as follows:

- Effectiveness and efficiency in the delivery of wildfire suppression and/or management activities to minimize losses to values-at-risk.
- Performance in responding to emergency fire situations through initial attack programs.
- Accountability to the public for results and expenditures, through the Minister of Alberta Environmental Protection.

In keeping with these principles, it is essential that any change in structure and organization help resolve the issues identified and helps to maintain or improve the current strengths. An organization must have the following attributes:

- Clear lines of authority and focused accountability.
- Transparency of organizational roles, responsibilities and business practices.
- Well-defined command and control protocols.
- Effective line of control—no more than five levels of authority from the fireboss to the Deputy Minister.

E. Alternative forest protection organizational models

Options for delivering a satisfactory forest protection program were considered and range from a return to the pre-1992 organizational model to a total reengineering of provincial wildfire management delivery structure. Five options have been identified and given different levels of consideration:

1. Return to the original pre-1992 Alberta Forest Service program delivery model.

2. Retain the current organization and add staff to achieve program objectives.

3. Enhance the forest protection organization under direction of the Provincial Forest Fire Centre.

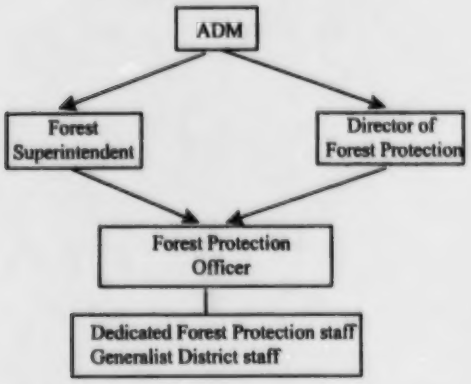
4. Enhance the forest protection organization under regional direction.

1. Return to the pre-1992 Alberta Forest Service Model

Although organizational change does not often consider a return to a previous model, this option is included due to the frequency of mention by many LFS and forest industry staff during interviews and focus group discussions.

Returning to the original AFS forest protection model involves more than simply restructuring the forest protection division. The pre-1992 AFS forest protection organization had a strong regional presence with the use of a Forest Protection Officer (a senior protection expert) as a focal point for program delivery. The strength of the regional presence was accomplished by the establishment of dedicated full time protection staff at forest headquarters (a total of 10 headquarters) and the integration of fire related duties with a strong complement of generalist district staff. Exhibit XVI-1 illustrates this organizational structure.

Exhibit XVI-1
Pre-1992 fire organization



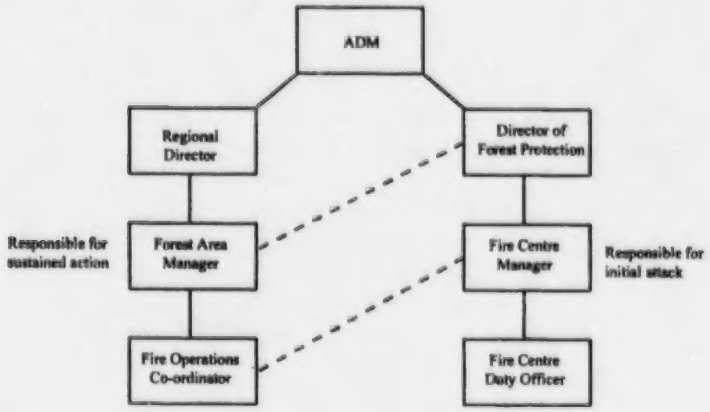
This option is not realistic in light of the many developments and significant organizational change since 1992-93. As such, this alternative was not evaluated further.

2. Retain the current organization and add staff to achieve program objectives

Throughout many of the interviews and discussions that were held regarding an improved forest protection program, the issue of a lack of manpower was raised with great regularity. A number of individuals believe that the key to delivering the Forest Protection Program more effectively is by adding people. For this reason, a second alternative is considered which involves simply raising the staffing level within the post 1998 organizational structure.

Retention of the "status quo" delivery would be the least disruptive to program staff. There is some value in minimizing the need to re-educate staff with respect to roles, responsibilities, procedures and command and control structures. This alternative would also preserve the positive aspects of the program which has been developed through the previous two years of organizational learning. Exhibit XVI-2 illustrates the organizational structure.

Exhibit XVI-2
Current fire organization



Advantages

- Minimal need for change and disruption.
- Preserves learning experiences relevant to the current organization.
- Potentially increases organizational capability through increased staffing.

Disadvantages

- Accountability remains unclear.
- Command and control structure remains diffuse.
- Lines of reporting and communication remain unclear.

Conclusion

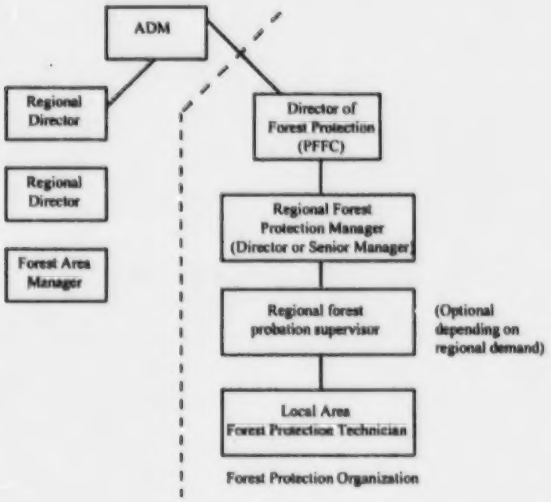
This alternative accomplishes little in terms of addressing the issues and concerns raised with the current organizational model. While adding staff may help alleviate some concerns regarding capability, this is not a recommended alternative.

3. Enhance the forest protection organization under direction of the Provincial Forest Fire Centre.

This option would serve the primary purpose of concentrating efforts of assigned forestry protection staff, while maintaining essential ties to the LFS. It represents a move towards increases utilization of dedicated staff while retaining generalist staff in the forest protection program to support fire management in the context of ecosystem/landscape management.

Enhancing the forest protection organization, in this alternative, is done in two ways. First, the lines of reporting, accountability and communication are clarified through a single chain of command through the director of forest protection. Secondly, staff are dedicated to the forest protection program at the local level (a Forest Area or some other logical base). Exhibit XVI-3 illustrates the structure proposed.

Exhibit XVI-3
Enhanced forest protection organization under PFFC



This alternative involves three general groups of forest protection staff required:

- Provincial staffing, as is currently the case, to coordinate provincial resources, programs and specialty support services (i.e. weather, fire research, airtanker management, etc)

- Regional staffing, to coordinate and deploy initial attack resources and to manage the delivery of the protection program in the field.

- Local area staffing, to work with communities, companies and stakeholders on an ongoing basis and to manage resources assigned to the local area for pre-suppression and suppression activities.

An estimate of the staffing required to implement this alternative is given as follows:

Provincial staffing:	No change	Approximately 25 dedicated staff
Regional staffing:	No net change	Approximately 16 dedicated staff
	A change from 1.5 dedicated FTEs for each of ten fire centres to 4 dedicated FTEs in each of four regions is estimated.	
Local area staffing	Increase	Approximately 60-80 dedicated staff
	Staffing dedicated to the forest protection program at the local level is estimated at an average of 4 staff in 15 to 20 offices.	

While the ongoing forest protection program would be managed by full-time protection staff at the regional and local levels, LFS staff in forest areas would still be used for fireline management positions (i.e. fireboss, sectorboss, etc.). The management of the program at the local level would not necessarily be based on forest area boundaries, but would utilize administrative boundaries best suited for forest protection purposes.

During periods of low fire activity, ongoing planning and operational activities would be managed by core staff assigned at each location. As hazards increase and activity escalates, the organization will have the option of moving staff between fire activity areas without constraints of regional boundaries or administrative areas. Policies would be concise and well understood within a single command structure.

Advantages

- Clear lines of reporting and communication.

- Clear lines of accountability.

- Greater ease in communicating with communities and industries through dedicated staff at the local level.

Disadvantages

- Difficulty maintaining communications between forest protection and the rest of the LFS.

- Increase in staff for forest protection at the expense of the rest of the LFS on

Conclusion

This alternative would improve the delivery of the forest protection program. Care and attention towards the maintenance of communication and relationships between the forest protection organizations and the rest of the LFS would be critical. Formal written agreements could be put in place to ensure that communication and human resource expectations and availability are clear.

4. Enhance the forest protection organization under regional direction

This alternative is a variation on the third alternative that emphasizes:

- Clear lines of authority and accountability.

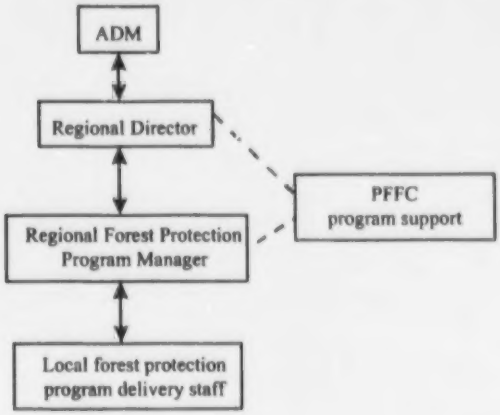
- Consolidated command and control structure.

- Fewer constraints related to administrative boundaries.

- Greater emphasis on a regional and local presence.

The third alternative involves a clear chain of command through a regional fire manager (or director), to a provincial director and to an ADM. The fourth alternative involves a chain of command to a regional director and then directly to an ADM as shown in Exhibit XVI-4. The Provincial Forest Fire Centre serves a support role rather than a command role in this alternative.

Exhibit XVI-4
Enhanced forest protection organization under regional direction



Staffing requirements with this alternative would be roughly the same as for the third alternative, however authority and accountability for the program would be significantly different. Rather than a director of forest protection being responsible for the program at a provincial level, regional directors would be responsible for the program at a regional level. This alternative would fit best with a more integrated approach to program delivery throughout the department, but would demand the following:

- The regional director would need to be fully aware of the forest protection command and control structure and protocol.
- Regional forest protection managers must be directly accountable to the regional director in all respects.
- The Provincial Forest Fire Centre must fully support the regional director in the delivery of the forest protection program.

Advantages

- Clear lines of reporting and communication.
- Clear lines of accountability.

- Greater ease in communicating with communities and industries through dedicated staff at the local level.

Disadvantages

- The Provincial Forest Fire Centre would function in a support role, rather than in a command/control role. Responsibility, accountability and authority would rest with a regional director rather than forest protection director. This is seen as a disadvantage by some wildfire management experts since required directors are not necessarily specialized in forest protection.

- Integration of programs between regions would require significant effort on the part of regional directors and the director of PFFC.

5. Comparative analysis of alternative program delivery structures

Exhibit XVI-5 shows a comparative analysis of the four alternatives presented against the principles and attributes needed of an effective forest protection program.

Exhibit XVI-5
Forest protection division organization comparison

Organizational attributes	Re-establish the pre-1992 fire organization		Add staff to the current organizational model		Enhance the forest protection program under PFFC direction		Enhance the forest protection program under regional direction	
	Pros	Cons	Pros	Cons	Pros	Cons	Pros	Cons
1. Clear lines of authority and focused accountability	• Lines of authority/ accountability clear to FPO (forest regional level).	• Lines of authority and accountability would not be clear in the current LFS organization.	• n/a	• No improvement in clarity of authority and accountability.	• Lines of authority/ accountability would be very clear.	• May experience difficulty separating authority between fire organization and the rest of the LFS.	• Lines of authority/ accountability would be very clear.	• May experience difficulty separating authority between fire organization and the rest of the LFS.
2. Transparency of roles, responsibilities and practices	• Roles and responsibilities clear for fire dedicated staff.	• Roles and responsibilities would still be unclear for Area Manager and Regional Director in terms of fire.	• No need to redefine roles and responsibilities.	• Some roles and responsibilities would remain unclear (i.e. Regional Directory Area Manager).	• Roles and responsibilities would be very clear.	• n/a	• Roles and responsibilities would be very clear.	• May experience difficulty integrating the program between regions.
3. Well defined command and control	• Command and control function well defined below FPO.	• Command and control would not easily fit with the current departmental structure.	• Preserves learning experiences relevant to current organization.	• Unclear command and control function would continue to beam issue	• Command and control structure would be clarified.	• n/a	• Command and control structure would be clarified	• n/a
4. Effective lines of communication and control	• n/a	• No change, or an increase in line of control.	• n/a	• No change in lines of communication and control.	• Line of communication and control can be simplified.	• n/a	• Line of communication and control can be simplified.	• n/a

Alternatives three and four both address the key issues and offer a greater number of advantages and fewer disadvantages than alternatives one and two. The Alberta Fire Review Steering Committee strongly supports alternative three—Enhancing the forest protection organization under the direction of the Provincial Forest Fire Centre. The Steering Committee believes that focusing accountability for program delivery on a regional director, as proposed in alternative four, is not appropriate given the specialized nature of the program and need for provincial coordination.

KPMG believes that either alternatives three or four are reasonable since both address issues of command and control, accountability, responsibility, area boundaries and community/industry contact. Alternative four places new and challenging responsibilities on a regional director—responsibilities that would have to be assertively managed and delegated. Alternative four also places demands on Regional Directors to coordinate the programs on a provincial level.

F. Recommendations

38. The LFS should enhance the forest protection organization by creating more direct lines of communication and reporting, by simplifying the command and control structure and by focusing accountability. The forest protection organization should deliver all prevention, planning, pre-suppression, detection and suppression programs. This involves the addition of staff at the local field level who work within the organization on forest protection related duties full time throughout the year and who report to forest protection managers within the forest protection organization at a regional level. The organization should focus on regional and local program delivery.

    In creating the enhanced organization, the LFS needs to consider reducing the number of "quasi-regional" centres in the fire program from 10 to 4 to:

    - Reduce administrative boundary conflicts.
    - Create clear lines of authority.
    - Focus accountability.
    - Establish a sound command and control structure.

39. In concert with this organizational change, the LFS needs to increase the number of managers and staff at regional and local field locations in order to manage the delivery and administration of the program.

40. Emphasis must be placed on defining the continuing role of all LFS staff in the Forest Protection Program by defining levels of service to the fire program and by maintaining sufficient numbers of certified fire positions to be available in times of need. The new organization should be able to rely on all LFS staff during highly active fire situations.

41. Organizational change should be led by a senior manager and group within the LFS who are dedicated full time to the task of designing and implementing the new organization.

    The move to a new organization must be designed quickly and be operational in a matter of months. Once defined and established, the organization should be allowed to remain stable and relatively free of fundamental change. This stability will allow staff to define roles and mature in their professions.

XVII

Aboriginal Communities

The Aboriginal community is a key sector in Alberta that must be considered for the future development of the Forest Protection Program in Alberta. This section discusses the current and emerging issues of Aboriginal communities, as they pertain to the Forest Protection Program and involvement of First Nations and Metis Nations people. The section will also discuss issues of importance to the Land and Forest Service (LFS) and provide recommendations for development of partnership arrangements between the LFS and Aboriginal community.

In the past, there have been mixed reviews of the relationships that exist between Aboriginal communities and Land and Forest Service. Both sides have echoed the need for improved communication but to date, no formalized communication mechanism has proven successful. The following discussion provides a discussion of the current state of the Land and Forest Service relations with Aboriginal communities and where it needs to go in the future.

A. The basis for mutual understanding—Aboriginal and treaty rights

For the Aboriginal people who live in Alberta's forests, care and conservation of the natural environment is integral to their spiritual, cultural, and social well being. Aboriginal people view forest protection as a key element in the sustainability of their way of life. Direct involvement in the planning and delivery of the Forest Protection Program is viewed as a natural and realistic means of developing an economic strategy, and contributing to the provincial economy.

The Alberta LFS has traditionally involved and employed Aboriginal people in the Forest Protection Program. Many of Alberta's finest fire fighting crews and field staff come from the Aboriginal Community.

A discussion of Aboriginal involvement cannot begin without an understanding Aboriginal and treaty rights—which are not only important in discussing forest protection but also relevant to determining values-at-risk as discussed in Chapter XVIII.

Aboriginal people have legally protected Aboriginal and Treaty rights distinct from other Canadians. These rights must be taken seriously and, in many circumstances, Aboriginal and Treaty rights have priority over other interests. Both Canada and Alberta are required to uphold their "fiduciary obligations"[3] to Aboriginal people in regard to these rights. These requirements are characterized as trust-like, and require governments to act in the best interests of Aboriginal people through meaningful and comprehensive discussions and programming.

Although they appear to be the same, the source of these rights are different. Treaty rights were negotiated and then written into Treaty documents. The Treaties were made with "Her Majesty the Queen of England in The Right of Canada" and not with Alberta. The province may not alter or change the Treaties and must accept the Treaties applicable within its boundaries.

Treaties did not replace or subsume Aboriginal rights. The Constitution Act, 1982, Section 35(1) states, "The existing Aboriginal and Treaty rights of the Aboriginal people of Canada are hereby recognized and affirmed." Aboriginal rights arise from distinct customs, practices, and traditions integral to the distinctive cultures of Aboriginal people prior to contact with Europeans. This definition does not fit with respect to Metis, and the courts have not given clear direction on what will constitute Metis Aboriginal Rights. An Aboriginal right cannot be created by the courts, it must have previously existed, and once it is identified, is then protected by Section 35. An Aboriginal group claiming a right has to prove it exists to the satisfaction of the courts through oral evidence of elders or historical records.

In Saskatchewan, the court of Queen's Bench in R. vs. Morin and Daigneault, 1997 determined that a specific Aboriginal right to fish exists for the Metis of northwestern Saskatchewan. The Metis Aboriginal right comes from subsection 35(1) of The Constitution Act, 1982, and section 35(1) is made applicable to Metis by section 35(2) which states that Aboriginal people of Canada includes the Indian, Inuit and Metis peoples of Canada.

The Northwest Metis right differs slightly from the Supreme Court definition of an Aboriginal right, as Metis Aboriginal rights originated after contact with Europeans. This decision demonstrates that the court may take a broad interpretation of Aboriginal rights, particularly where hunting or fishing rights are concerned.

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[3] *Fiduciary—The Supreme Court of Canada has characterized the relationship of the Crown to Aboriginal people as fiduciary as "special trust relationship". The Honour of the Crown must be upheld, and there is a general duty of the Crown to act in the best interests of the Aboriginal people.*

B. Different cultures, different perspectives—the importance of building lines of communication and partnerships

There are obvious differences to overcome when two distinct cultures must work together to find a common solution to a mutual challenge and forest protection is not exclusive to this dynamic. What is important in finding a solution is to, first, clearly identify the problem—in this case, ineffective communication has not enabled Aboriginal communities to contribute to forest protection as they have historically. Based on the interviews conducted by KPMG, it was apparent that the level of effective communication between the LFS and Aboriginal communities has eroded as a result of a reduction in local fire managers. The absence of a local presence has allowed the gap in understanding to widen, resulting in the current lack of support on either side towards working towards improved forest protection initiatives. The following sections provide a synopsis of the current viewpoints of both Aboriginal communities and the LFS.

1. Aboriginal viewpoint

- Many of the attitudes of the past (i.e. "do for us") have been replaced by new attitudes (i.e., "we will do for ourselves"). Whether this new ideology is contained in micro-program issues or macro-constitutional issues, there is a new way of doing business in the Aboriginal community.

- These new attitudes are prompting Aboriginal groups to seek opportunities to take charge of affairs which affect their economic and social well-being.

- Aboriginal perspectives or rationale for forest protection occasionally vary from those of the forest industry or other industries based within the forest. Most Aboriginal communities agree that protection of current and future timber stock is important. These communities also look to the land for sustenance and the preservation of a way of life. Thus, many believe that protection of less productive forests around communities is of equal importance to protection of some timber supply areas.

- Aboriginal leaders suggest that it is reasonable to concentrate Forest Protection efforts in areas with higher values at risk (i.e. 1998—Whitecourt/Slave Lake), however, overall policy should provide equal consideration to all areas of the province, including the north.

- The advent of advanced technological applications to forest protection has changed the way the province and Aboriginal communities do

business. Opportunities for participation in forest protection programs appear to have decreased dramatically in the last decade.

- Aboriginal communities and leaders have the perception that LFS staff have a fundamental misunderstanding of First Nations and Metis Nations government and organization. This misunderstanding often results in miscommunication and incorrect interpretation of policies and programs.

- The Terms of Reference of the Alberta Fire study did not address specific concerns of Aboriginal groups. There is dissatisfaction with the absence of Aboriginal issues in Part I of the study.

- New training, certification standards and Occupational Health and Safety requirements places new demands on Aboriginal crew members and eliminates many knowledgeable and capable firefighters and local crew leaders.

- First Nations and Metis Nations groups do not perceive any real opportunities to participate in the Forest Protection Program beyond supplying ground fire fighters and laborers in relatively minor roles. This is seen as disappointing and frustrating vis-a-vis their significant reliance on future opportunities for economic development within Alberta's forests.

2. Alberta Land and Forest Service viewpoint

- The Forest Protection Advisory Committee has three seats available to First Nations representatives representing three tribal areas. To date only one seat has been attended by a treaty eight representative. Seats offered to Metis Nations representatives have been well attended.

- The LFS has sponsored three sub-committees: the municipal sub-committee, the forest industry sub-committee, and the Aboriginal sub-committee. The intent of the sub-committees is to seek input into the development of the Forest Protection Program on a sectoral basis, thereby guaranteeing adequate and informed protection policies specific to each sector. To date there has been no progress in developing the Aboriginal sub-committee due to a perceived lack of interest by Aboriginal groups.

- Rapid expansion of the forest industry, coupled with downsizing, resulted in experienced field staff and experienced Aboriginal firefighters leaving jobs in industry. The creation of jobs in the industry is a very positive

situation, however, the resultant loss of experienced forest protection expertise is a negative factor.

- Land and Forest Service downsizing and reorganizing resulted in a loss of daily or expedient contact with some communities, as some forest districts closed in favour of more central administrative districts/areas with fewer staff.

- The need to comply with more stringent and encompassing Occupational Health and Safety requirements, coupled with the application of National Standards in training of firefighters, has eliminated or estranged many Aboriginal firefighters.

- Aboriginal crews have not kept pace with education, training and fitness requirements.

- The Wildland Firefighting Unit (W.F.U.) program is intended to promote and introduce a private sector contractual approach to firefighting employment. The program provides individuals and communities with self employment opportunities.

C. Discussion

There is an obvious disparity in the views of the Forest Protection Program by Aboriginal groups and the LFS. On the one hand, Aboriginal groups are seeking recognition of their rights, confirmation of governmental fiduciary obligations, and recognition of their political institutions. On the other hand, the LFS recognize these rights, and the government to government relationships. The issue for the LFS however, is to strike a balance between recognition of rights and obligations, and their mandated land and program management obligations to the citizens of Alberta. Generally the LFS appears to be frustrated that their genuine attempts to improve the Fire Protection Program are continuously stalled by Aboriginal insistence on the primacy of political issues and settlement of past grievances.

Although the LFS has acknowledged the importance of improved dialogue, there still needs to be recognition that, due to cultural differences, the same procedures and approaches that are successful among other stakeholder groups are not necessarily the key to success with Aboriginal stakeholders.

Discussions with LFS staff reveal that there is a desire by the LFS to adopt direction handed down by the Supreme Court (R. vs. Sparrow; R. vs. Nikal). These tests outline how federal and provincial laws must be justified if they interfere with constitutionally

protected Aboriginal or Treaty rights. The LFS has adapted to the directions handed down by the Supreme Court and has undertaken to improve dialogue with the First Nations and Metis.

In seeking a balance of understanding in the development of a consultation process leading to resolution of jurisdictional and operational issues, each group must understand the following about each other:

1. First Nations and Metis Nations

- Both First Nations and Metis Nations are reluctant to engage in consultation because it is seen as a process leading to the weakening of Treaty or Aboriginal rights. First Nations characterize the process as the slow "shaving away" of Treaty Rights.
- For Aboriginal people, taking part in consultation means "consent". This is not how the Supreme Court of Canada has defined consultation.
- Aboriginal people are concerned that any dialogue can be viewed as consultation.
- Silence from First Nations or Metis on any policy which may infringe on their rights is often interpreted as acceptance which may not always be the case.

2. Land and Forest Service

- The LFS has a legislated mandate to manage the forest land within the boundaries of Alberta.
- The LFS takes that mandate seriously, and is diligent in development of programs which are intended to ensure public safety and protection of forest land.
- The Province, hence the LFS, does not recognize a proprietary interest in "traditional lands" by Aboriginal people. The Province believes such proprietary interest was replaced by established Treaty lands. The Province does, however, recognize traditional uses of land and resources such as hunting, fishing and gathering.
- The LFS is concerned that apparent continual reluctance of Aboriginal groups to meet and agree on program development, will lead to increased alienation.

It seems obvious that a process for improving communication and building effective partnerships and relationships between the LFS and Aboriginal groups needs to be developed. In approaching the subject of building an effective partnership between Aboriginal groups, government and industry, a paper entitled "A Framework and Plan of Action for CAAP" (Canada's Aboriginal Action Plan) by professor Moses N. Kiggundu defined a true partnership:

> *"True partnership is a mutually beneficial relationship among groups with identifiable joint rights, responsibilities and obligations. It is characterized by shared values and a willingness to work together toward common shared goals. Partnership must not be a passing fad or a one-mandate commitment to change. Rather, it must be built to last and seen by partners and stakeholders as a long term, on-going dynamic strategy for positive change. This means that the partners must have the capacity to retain their respective core values while at the same time bringing about significant changes in the relationships among partners and stakeholders."*

A guideline for developing a three-way partnership is provided:

Indigenous guidelines	Corporate guidelines	Government guidelines
1. Form a Representative Group.	1. Respect local customs and etiquette.	1. Establish and enforce sustainable policies for natural resources in the interest of the Indigenous people.
2. Predict all the possible impacts of the project.	2. Predict all the possible impacts on the community.	2. Develop sustainability strategies by involving all stakeholders.
3. Don't be left out: Get involved.	3. Don't leave Indigenous people out: Get them involved.	3. Separate government agencies that exploit from those which regulate resources.
4. Rules: Ask lots of questions.	4. It is to your long term advantage to play straight.	4. Enforce the traditional resource rights of Indigenous people.
5. Use your traditional knowledge.	5. Communicate so that Indigenous people understand.	5. Protect Indigenous people from undue outside influence so they can preserve and develop their cultures, languages, etc.
6. Insist on your rights: Know your bottom line.	6. Respect Indigenous intellectual, cultural and traditional rights.	6. Be aware of relevant international statutes and conventions as they relate to Indigenous people.
7. Find out what other partners know and how they operate.	7. Work with traditional knowledge.	7. Invest in capacity development for Indigenous people, organizations and nations.
8. Know what your people need and want.	8. Negotiate based on equity, empowerment and respect: Do not be greedy.	
9. Find out what they want from you and why.	9. Provide local community with complete information.	
10. Don't be outmaneuvered.	10. Don't be too legalistic.	
11. Get other neighboring communities involved.	11. Negotiate mutually acceptable dispute resolution mechanisms.	
12. Communicate directly with government agencies.	12. Invest in the development of partnership capacity.	

Source: Guidelines for Environmental Assessments and Traditional Knowledge. Canadian International Development Agency, March 1997, pp 71 - 74.

D. Recommendations

42. Develop a culturally-sensitive communication mechanism to develop input and support for Forest Protection Program initiatives that reflect Aboriginal viewpoints and values-at-risk.

43. Support on-going initiatives to put additional dedicated resources in the Wildland Fire Fighting Units which will serve to facilitate two-way communication locally as well as provide an important organizational tool for coordinating Aboriginal fire crews.

XVIII

Reducing Industry Impacts On Fire Hazard And Risk

The various industries that operate within Alberta's forests have a number of impacts on the risk and hazard of wildfire. Some of these impacts may be considered negative, such as those activities that increase fuel loading or risk of ignition. Others may be beneficial such as those activities or impacts that provide for the development of fire breaks or landscape changes that help "cool down" the forest. An assessment of these impacts is important to developing effective fire management policies by helping the policy makers decide where to make changes or additions to the current fire management regulatory and policy framework.

The evaluation of impacts by industry was carried out by reviewing the current policies and practices of government and industry, by reviewing documentation and literature respecting past experiences, and by interviewing key industry and forest representatives involved in field operations, enforcement and policy development.

The research and evaluation of the impacts of industry and operation on fire management was centered around the following topics:

- Hazard creation/reduction.
  - Physical activity.
  - Fuel increase.
  - Fuel type change.
- Suppression support.
  - Access.
  - Fuel breaks.
  - Fuel concentrations.
- Policies.
  - Activity timing.
  - Fuel treatment requirements.

A matrix of fire management impacts against activities has been developed as the best tool for communicating the findings of this research and is presented in Exhibit XVIII-1. The matrix points to the issues that need to be addressed as priorities. A rating system used to evaluate the impacts indicates where effects are neutral (rating of "0"), beneficial (rating of + or ++) and where impacts are of a detrimental nature (rating of - or - -).

The main impacts with respect to industry operations and fire management are as follows:

1. Logging activities and the associated increase in fuel loading due to in-block and roadside processing. Both practices have an impact, yet in different ways.

2. Stand tending operations and impacts on fuel loading, fuel concentration and fuel type changes.

3. Seismic operations and impacts on fuel loading that results from an increase in the growth of grass along seismic lines and the creation of windrows consisting of woody debris. Both grass and windrows act as wicks.

4. Pipeline construction/operation and the impact on fuel loading that results from an increase in the growth of grass along right-of-ways.

5. Powerline operations and the increased risk of fire associated with trees falling on live lines, and the growth of grass along right-of-ways.

6. Agricultural land clearing and the increased hazard and risk associated with brush piles and debris burning.

7. Recreation activity and the risk of fire associated with increased public use of the forest and improper care and attention of campfires.

A. Logging activity

Logging activities impact fire management by increasing the fuel loading as fine fuels build up after the processing of timber either within the block, through falling and skidding phases, or at the landing or roadside. Since most processing operations are at roadside, most of the limbs, tops and leaves/needles are removed from the cutblock. These fine fuels are then concentrated at roadside to be either piled and burned later, or spread back into the block. The impact of this type of fuel increase and concentration depends on the type of operation (conifer or deciduous) and the timeliness of fuel treatment (i.e. whether burnt or scattered within the block). The impact of both summer and winter logging on fuel loading is considered to be a short-term problem for two to three years until the block has greened up.

Exhibit XVIII-1
Industry impact matrix

	Hazard			Suppression support			Policies			
	Physical activity	Fuel loading	Fuel type change	Access	Fuel breaks	Fuel concentrations	Activity timing	Fuel treatment requirements	Risk of ignition	Overall impact on fire mgmt
Logging										
Summer	-	-	0	+	+	0	adequate	adequate	-	0
Winter	0	-	0	0	+	0	adequate	adequate	0	0
Silviculture										
Stand tending*	0	--	--	0	0	--	adequate	adequate	-	-
Others	0	0	0	0	0	0	adequate	adequate	0	0
Seismic										
Summer*	--	--	--	+	+	-	adequate	needs improvement	-	-
Winter*	0	--	--	+	+	-	adequate	needs improvement	0	-
Wellsite construction, drilling, operations										
Summer	0	+	0	+	+	0	adequate	adequate	+	0
Winter	0	+	0	+	+	0	adequate	adequate	0	0
Pipeline construction operations										
Summer	-	-	-	+	+	0	adequate	adequate	0	0
Winter	0	-	-	+	+	0	adequate	adequate	0	0
Powerline construction										
Summer	0	-	-	+	+	0	adequate	adequate	0	0
Winter	0	-	-	+	+	0	adequate	adequate	0	0
Powerline operations										
Mining	0	0	0	+	+	0	adequate	adequate	0	0
Agriculture										
During clearing*	-	-	-	+	0	-	adequate	adequate	-	-
After clearing	0	0	0	+	+	0	adequate	adequate	0	+
Recreation*	-	0	0	+	0	0	inadequate	adequate	--	-

The physical activity of logging also contributes somewhat to hazard and risk of ignition, particularly where logging operations take place in the summer. The impact of summer operations on hazard and risk varies with the fire weather (summer logging normally does not occur during spring hazard) and is mitigated by crew training and equipment availability and serviceability.

Logging operations as with many other clearing activities in the forest, can have a positive impact on fire management. If planned appropriately as they provide access into the forest for fire suppression activities and can create fuel breaks. Furthermore, if improved integration occurs between fire management and forest/timber management, logging operations can be used as a tool to affect fire hazard.

There are numerous policies both regulatory and corporate that exist to control summer logging activities. These include:

- Fire control agreements.
- Fire control plans.
- Annual operating plan conditions.
- Corporate policies regarding activities.
- Hazards.
- Ability for the forest service to order a closure to operations.

For the most part, these policies and regulations are adequate in minimizing the detrimental impacts of logging operations on fire management.

B. Silvicultural operations

The primary concern with respect silviculture operations and fire management lies with stand tending activities. Stand tending, particularly pre-commercial thinning, results in a buildup of fine and medium fuels that can quickly become a serious concern regarding ignition and initial spread.

Slash hazard abatement requirements are typically included within stand tending contracts. The problem, however, is that these requirements are not necessarily standard across the industry or across the province. Improvements can be made in this area by developing more consistent approaches to the approval and control of thinning operations on crown land.

C. Seismic programs

Where seismic programs are utilizing existing lines or other forms of low impact access, the impact on fire management is essentially nil. New lines, however create a potential hazard by providing an opportunity for grass to proliferate and by establishing a corridor which could increase the rate of fire spread quite dramatically (the "wicking" effect).

The increase in hazard that results from the establishment of grass is primarily a springtime issue. Once greenup occurs, the hazard associated with grass and linear disturbances decreases.

The hazard associated with windrows of woody debris is also a concern from the perspective of this "wicking" effect. Disposal or treatment of debris has not been effectively dealt with by existing operational policies, primarily due to the lack of enforcement and lack of consistency.

D. Pipeline construction and operation

Where pipeline programs are utilizing existing right-of-ways, the impact on fire management is essentially nil. New rights-of-ways however create a potential hazard similar to that of seismic lines by providing an opportunity for grass to proliferate and by establishing a corridor which could increase the rate of fire spread.

The increase and hazard that results from the establishment of grass is primarily a springtime issue, as for seismic lines.

E. Powerline operations

The establishment of powerlines within a forested environment creates a similar hazard as that for seismic lines and pipelines where the establishment of grass creates a spring hazard along the powerline right-of-way. A more significant issue with respect to powerlines, however, is the risk of ignition caused by trees falling on powerlines.

The risk of ignition raises two key issues. The first issue is the right-of-way width associated with the powerline and the second issue is the removal of danger trees adjacent to the right of way that pose a potential hazard if fallen by wind into the powerline.

Many FMA holder and LFS field staff responsible for landuse approvals tend to favour narrower rights of ways in an effort to minimize damage to the timber resource and deletions from the productive land base. Individuals in the power utilities industry tend to favour wider rights-of-ways in an effort to minimize the chances of adjacent trees falling on powerlines and igniting fires. Industry usually carries some liability with respect to this type of fire ignition and are therefore understandably interested in minimizing this risk.

The second issue relates to the practice of "tree freeing", or removing trees adjacent to the powerline that have the potential to fall on the powerline and ignite a fire. Currently a tree freeing plan is submitted to the LFS and FMA holders for approval each year as part of a wildfire agreement that power companies have with the Crown. The plan identifies specific danger trees and the removal of each tree requires approval. The approval process is time consuming and difficult—tree freeing programs are typically well behind schedule.

There is a need for a formalized agreement between powerline operators with both the LFS and FMA holders to allow powerline brushing teams to remove danger trees as part of their on-going patrolling efforts. In the past, there has been a reluctance on the part of some FMA holders to allow powerline operators to remove individual danger trees, which is counterproductive for all parties concerned with respect to forest protection.

F. Agriculture

Agriculture has long since been an area of concern or attention as it relates to forest fire management. Policies and practices around burning permits and education has, for the most part, proven to be effective. The fact that agricultural operations in and near the forest protection area typically deals with land clearing and debris disposal by burning, agriculture will always be a significant issue with respect to hazard and risk.

Continued monitoring enforcement of current policies and regulations is essential to minimize the risk and hazard associated with the agricultural industry.

G. Recreation

Recreational use of Alberta's forests is increasing dramatically and back country recreation is a particular concern with respect to fire management.

Outfitters specializing in backcountry trail riding and hunting excursions during the spring, summer and fall are increasing the number of people using public land in the green area. Authority or permits are issued for this purpose and some control is possible through the permitting process. It is very difficult, however, for the Land and Forest Service to fully monitor this increased use and fires started in backcountry areas are typically very difficult to access and action in a quick manner.

It has been noted by LFS staff that May and June are the peak problem months in the eastern slopes region from Grande Prairie to Castle River. Prevention, detection and suppression efforts must be focused on these peak months in order to address this particular issue. It was noted that the level of staffing in forest areas makes it difficult for the LFS to increase lack country patrols.

H. Conclusions

It has long been known that industry operations, including the use of forest by the public, have a significant impact on fire management practices. Primary areas of concern relate to:

- The increase in fuel loading, which adds to the likelihood of fires starting (fine fuel loading) and building (medium to heavy fuel loading).

- The increase in the amount of grass present throughout the forest which contributes to a very high springtime hazard when the grass is cured and easily ignited. Other primary concerns relate to practices associated with commercial and pre-commercial thinning, and practices related to the management of hazards along powerline right-of-ways.

I. Recommendations

44. Fuel loading and fuel type changes resulting from stand tending operations must be managed very carefully through a more complete set of policies and guidelines for debris disposal and hazard reduction. These policies should include guidelines for the treatment of fine fuel hazard reduction and consistency across the province.

45. Strictly enforce hazard reduction requirements on seismic line operations, particularly where breaks in the debris windrows are required. A greater use of debris spreading in certain fuel types should be considered as a hazard reduction technique where appropriate.

46. A variable width for powerline right-of-ways should be employed for powerlines located in forested areas. A wider right-of-way can be used when adjacent trees are taller and more mature and narrower right-of-ways can be used through clearings and areas of stunted tree growth. This approach should be addressed at the planning stage for the land disposition application.

47. Place priority on implementing tree freeing plans along powerline right-of-ways. The LFS should work with companies to ensure that tree freeing activities are taking place. To assist, it is recommended that a one day course or seminar be developed for the purpose of educating individuals from power transmission and distribution companies about the standards and practice of identifying danger trees and removing them in a safe manner from the area adjacent to the powerline. Once this one day seminar or course is developed and offered, the LFS and FMA holders should more consistently provide authorization for tree freeing operations where trained and certified individuals

are making the decision and taking action to remove danger trees adjacent to powerlines.

XIX

The Mutual Aid Resource Sharing Agreement And Alberta's Strategic Reserve Of Firefighters

A. Introduction

This chapter focuses on the use of the Mutual Aid Resources Sharing (MARS) agreement and Alberta's strategic reserve of firefighters. It is the trained firefighter who is the most important link in the system, building and holding fire lines and ultimately extinguishing the fire. Alberta has a multi-tiered Wildland Fire Fighting Unit System consisting of WFU I initial attack crews, WFU II intermediate level crews and WFU III sustained action crews.

The need for trained firefighters, overhead and service personnel in any fire agency is dependent upon the fire requirements, expected fire statistics, fire weather and the level of protection dictated by policy. The demand for these important ground personnel surges and subsides with the annual, periodic and daily fire related conditions and events. No single agency can be expected to provide for the maximum number of personnel needed for fire suppression in the worst fire situations. Historically, firefighter inventory thresholds have been established with an objective of allowing the agency to meet the peak demands of seven or eight fire seasons out of 10.

Given the expectation of falling short on firefighter availability during peak situations, strategies are required to allow access to trained firefighters in a timely fashion from other sources. Mutual aid strategies employed to access additional firefighter resources can include border agreements with neighbors, partnerships with forest industry and others, and specific arrangements to share resources from other provincial and territorial fire agencies.

In Canada, a well-developed mutual aid system is in place, operated by the Canadian Interagency Forest Fire Centre (CIFFC) and the attendant Mutual Aid Resource Sharing Agreement (MARS) and Canada/U.S. Reciprocal Agreement. Alberta has been a significant participant in the mutual aid arena for many years and in 1998 (and 1999) accessed significant amounts of resources to cope with the extraordinary fire loads.

B. The Mutual Aid Resource Sharing Agreement

As indicated, the need for additional trained firefighters surges and subsides with the fire weather, fire arrivals and values at risk. Fire agencies in Canada are usually funded to provide for their initial attack and sustained action needs for all but the worst severe fire situations. Prior to the establishment of CIFFC in 1982, agencies relied on adhoc arrangements and agreements with other jurisdictions to meet their peak demand needs. Since the creation of CIFFC, more formalized resource sharing protocols have been used by the Canadian fire community. These include the Mutual Aid Resources Sharing (MARS) Agreement for in-Canada resources and the Canada/U.S. Reciprocal Fire Agreement for mutual aid from U.S. fire agencies.

The MARS agreement provides for the sharing of people, suppression equipment and aircraft with agencies in need of emergency and preparedness resources. This agreement provides the mechanism for these resources to be moved quickly, and for the assignment of costs associated with the transactions.

Source data reflecting the experience and use of MARS is appropriate. Exhibits XIX-1 and XIX-2 show the number of fires and hectares burned across Canada by year. Exhibit XIX-3 shows the number of personnel mobilized through the MARS agreement since 1982. In spite of several significant fire years—large numbers of fires and area burned—the use of mutual aid and the MARS agreement was minimal for the first 13 years of its existence. Beginning in 1995 and continuing to present there has been a dramatic increase in the amount of equipment, aircraft and firefighters moved between jurisdictions through the MARS agreement.

Exhibit XIX-1
Fires by year

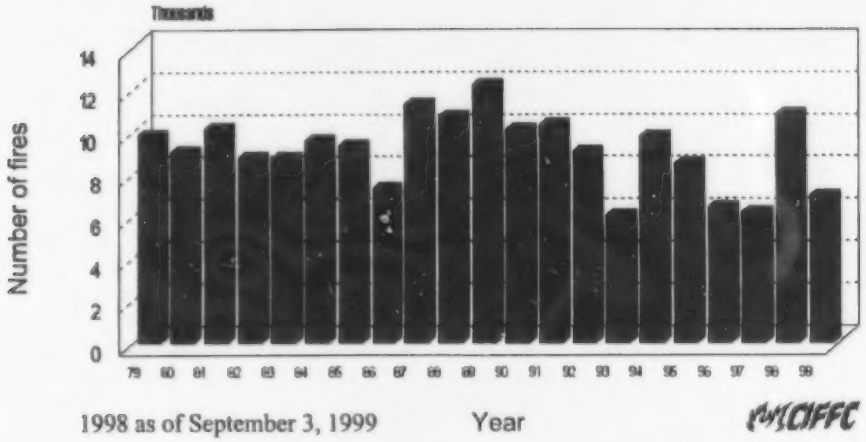
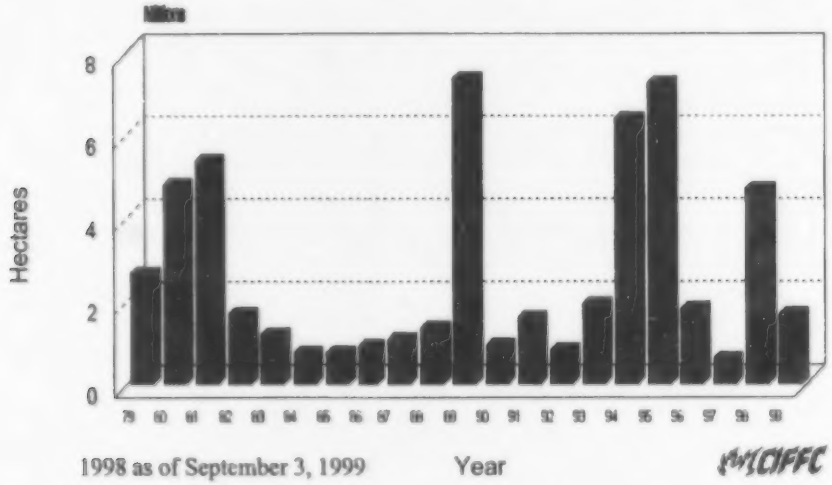


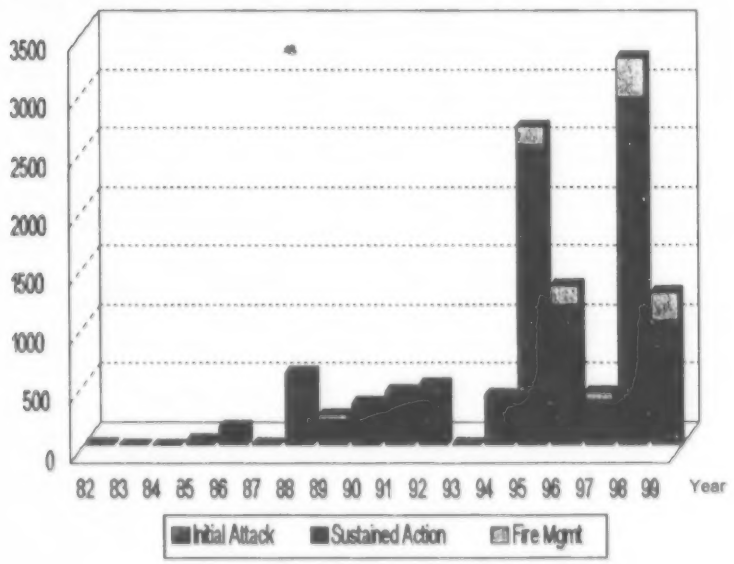
Exhibit XIX-2
Number of hectares burned in Canada



There has been a dramatic escalation in mutual aid for the fire years 1995, 1996, 1998 and 1999. Apart from the fact that these were particularly severe fire seasons in many parts of Canada, there appears to be other contributing factors resulting in the increased use of MARS. One factor is that agencies have become more comfortable with sharing resources by developing and following national standards. Also, the stigma earlier associated with asking for assistance has been overcome.

Another more prevalent view is that government downsizing, budget cutbacks and reorganizations in all fire agencies across Canada have resulted in many agencies no longer having the necessary inventories of resources to meet even the average fire season demands. Coupled with this is the inability of source agencies to recapitalize their resources on an annual basis as was the case in the past. Whatever the reasons the data does indicate that mutual aid is now a key component of the strategy employed by many Canadian fire agencies to cope with excessive fire load.

Exhibit XIX-3
Personnel mobilized 1982 - 1999



C. Alberta's use of the MARS agreement

Alberta accessed the MARS agreement in 1998 (and 1999) to obtain large numbers of firefighters and overhead personnel to adequately resource and action our extraordinary fire load. This action was certainly appropriate; however, a number of questions have been posed by LFS staff and industry stakeholders.

- Why was it necessary for the large numbers of firefighters to be provided through MARS?
- Is Alberta a net contributor, net receiver or equal participant in MARS agreement?
- What is the ability of Alberta to draw on the reserve of firefighters in the Province?
- What are the issues associated with developing and monitoring a strategic reserve of firefighters versus relying on the MARS agreement for significant input?
- Is it cost effective to import firefighters at these threshold levels?

A review was undertaken of the MARS data summaries from CIFFC. Accurate and complete data is available for the period 1994 to 1999 inclusive.

The resource order summaries by shipping and receiving agency are detailed in appendix C. This summary is further developed in exhibit XIX-4.

Exhibit XIX-4
National summary MARS—six years

Agency	% total shipment	% total receipts
BC	23.3	7.4
AB	12.7	15.7
YT	1.6	12.7
NT	7.7	5.4
SK	7.2	9.7
MB	10.2	2.6
ON	10.7	26.2
QC	6.9	12.0
NB	1.8	1.3
NS	1.3	0.3
PE	0.0	0.0
NF	2.5	0.3
Other	13.9	6.5

From a national perspective, Alberta has gone from being one of the nation's significant suppliers of resources through mutual aid—varying from 11% - 30% over the life of MARS—to receiving more than 38% of all the mutual aid shipments in Canada in 1998.

Again in 1999 (to September 28) Alberta requested and received 30% of all of the shipments processed by CIFFC.

For the last six years Alberta has been a net receiver of resource orders and ranks third in the country in this category (behind Ontario and Quebec). However for the same period of time Alberta has ranked third as the largest shipper. Virtually all of the receipts for Alberta were actioned during the 1998 and 1999 fire seasons.

A closer analysis of the impacts for the period is provided in Exhibits XIX-5 and XIX-6.

Exhibit XIX-5
Alberta fire resource orders
(1994 - 1999)

	% of national orders	
Year	Received	Shipped (%)
1994	0.00	21.40
1995	0.03	10.80
1996	0.00	27.00
1997	0.00	30.00
1998	38.30	00.02
1999	30.00	11.40

Source: CIFFC Resource Order Summaries.

Exhibit XIX-6
Summary of receipts by category

Year	Total resource order requests	Personnel crews/OH	A/C (Group)	Equipment
1994	0	-	-	-
1995	5	180	2	40 pumps, 1200 hose
1996	0	-	-	-
1997	0	-	-	-
1998	67	2365	14	280 pumps, 4485 hose and special equipment
1999	114	754	7	122 pumps, 9600 hose and special equipment & fireline tools

Source: CIFFC Resource Order Summaries.

Alberta's use of MARS dramatically increased in 1998 and 1999. Of particular note is the reduction of the number of personnel imported to Alberta—2365 in 1998 and 754 in 1999. The import of personnel for Alberta is further detailed in Exhibit XIX-7 which includes both CIFFC data and LFS data on imports from outside of Canada.

Exhibit XIX-7
Personnel imports (1998 and 1999)

Year	Initial attack personnel	Sustained action personnel	Overhead/ specialists
1998	351 *(88 crews)	1719 **(172 crews)	208
1999	432 (108 crews)	284 (28 crews)	122

Source: CIFFC Resource Orders Summary and LFS data.

Note: does not include Military personnel at Virginia Hills - 56.

* *Assuming 4 persons/crew.*

** *- Assuming 10 persons/crew.*

In evaluating personnel imports, it was noted that crew sizes vary between three and five for Initial Attack (I.A.) crews and between eight and 20 persons for sustained action (S.A.) crews. For compilation purposes, it is assumed that I.A. crews are 4 persons and S.A. crews are 10 persons.

LFS managers indicated that Alberta experienced a significant shortage of trained initial attack personnel to action new fire arrivals. These I.A. crews take 24-48 hours to arrive on scene from other provinces and in 1998, most were assigned to sustained action duties on large fires. This shift in resources from initial attack to sustained action also indicates the need for more sustained action personnel available from Alberta (WFU II crews).

For both categories—there is a need to establish a threshold of resident crews above the inventories that existed in 1998.

D. Fire fighter strength in Alberta

A business strategy for the development of Wildland Forest Firefighting Units was accepted in 1997 and work has been underway in implementing the five year plan. Basically this initiative has resulted in a multi-tiered firefighting force for Alberta consisting of:

WFU I Units:	Certified initial attack personnel (seasonal).
WFU II Units:	Certified intermediate level firefighter—capable of flanking action and sustained action— (seasonal contract crews).
WFU III Units:	Base level sustained action crews (hired as needed).

In 1998 all of these WFU's were configured in eight person units. An independent review of this business strategy has been carried out to review progress to date and to recommend actions to meet the future firefighter needs of Alberta.

From the data reviewed the WFU inventory is as follows:

- *WFU I—34 crews *(*Data made available by LFS staff).*
- WFU II—30 crews.

The data is not clear as to when the certification records were reviewed or when the information system (FIRES program) was interrogated for specific dates in 1998 or 1999. There seems to be a problem with accurately accessing crew data in the system

For example, Exhibit XIX-8 indicates that on 1998/04/01 there were 3598 certified WFU III firefighters, leaders and subleaders available, according to regional data. The FIRES system, however, indicated that 4835 certified WFU III firefighters, leaders and subleaders were available. This is clearly a difficult discrepancy when considering its potential impact on decisions regarding resource deployment on wildfires.

Exhibit XIX-8
Summary of certified firefighters

Count of corporate region Certification status	Total
WFU I leader	28
WFU I subleader	19
WFU II leader	10
WFU II subleader	11
WFU III leader	196
WFU III subleader	409
WFU I-R leader	8
WFU I-R subleader	7
Wildland firefighter I	131
Wildland firefighter II	142
Wildland firefighter III	2,993
Wildland firefighter I-R	47
Grand total	4,001

Exhibit XIX-9
FIRES manpower by certification type
1998/04/01

Certification type	Certification type count
WFU I leader	11
WFU I subleader	8
WFU II leader	18
WFU II subleader	23
WFU III leader	196
WFU III subleader	439
WFU I-R leader	2
WFU I-R subleader	1
Wildland firefighter I	95
Wildland firefighter II	191
Wildland firefighter III	4,200
Wildland firefighter I-R	1
Total	5,785

All I and II's are seasonal suppression forces.
All III's are available for hire when needed.

The important issue is the true WFU III crew availability. Through the certification records indicate a minimum of 3598 and a maximum of 4835 WFU III firefighters on the roster, less than 1500 were actively available for fire duty in 1998. Less than half of the certified personnel were actually available. A number of circumstances impact on this availability including:

- Many of these certified people are employed in other work. A buoyant economy in Alberta has resulted in job opportunities for many of the people who traditionally look on the WFU III work.
- Limited career advancement or advanced training has been available for these people, resulting in the loss of firefighters to other opportunities.
- Fewer LFS staff available to support the WFU III program in the communities.
- Funding support for the program has been eroded.

The number of WFU III personnel available in Alberta for sustained fire action did not meet the demands in 1998 and in this situation resulted in a greater reliance on sustained action crews being imported under the MARS agreement.

To understand the magnitude of the numbers and types of personnel imported by Alberta versus the current inventories, two peak manning days were selected. For the 1998 fire season the peak manning day for "on-fire" personnel was August 12th and for 1999 it was July 23rd. The data is displayed in Exhibit XIX-10. These are direct on-fire numbers only, and do not include the hundreds of administrative and support personnel who were also on duty on these days.

Exhibit XIX-10
Maximum firefighter staffing on fires—peak days

Day	Crew type	Total	Percentage
August 12, 1998	MARS	302.0	12.0%
	WFU I	134.0	
	WFU II	286.0	
	WFU III	1616.0	
Total		2338.0	
July 23, 1999	MARS	190.0	9.5%
	WFU I	362.0	
	WFU II	473.0	
	WFU III	989.0	
Total		2014.0	

Source: LFS.

Two points are noteworthy in this table. Firstly even though Alberta has a certified inventory of between 3598 and 4835 WFU III firefighters, on the peak demand days in 1998 and 1999, the maximum number mobilized was 1616; about 1/3 of the inventory. Secondly, on these critical days Alberta had 9.5% and 12.9% of its fire fighting requirements met by the MARS agreement.

The assignment of WFU I and II crews (I.A. and seasonal contract crews) is given in exhibit XIX-11:

Exhibit XIX-11
Crew assignments

	August 12, 1998	July 23, 1999	Total inventory for province
WFU I	17	45	34
WFU II	36	59	30

Source: LFS
Note: Crew strength eight persons per crew

One can assume that the crew sizes were adjusted in 1999 to meet conditions and that some of the compliment of WFU I were on Initial Attack standby. However, for July 23, 1999 it does appear from the data that the entire inventory of WFU I & II's was over-committed. As a result, there is justification to increase the inventory strength for WFU I and II crews for anticipated active fire seasons marginally, and to increase the availability of WFU III's substantially.

E. Costing

The cost of training, operationalizing and sustaining the WFU crews was examined and compared to importing similar certified crews under MARS.

In order to conduct the cost analysis a number of assumptions had to be made regarding the allocation of costs. First, it was assumed that all crews consisted of eight members with each member holding a 62-day contract. This assumption was necessary because actual statistics were not recorded in the data files from the LFS. A second assumption was that training costs were included for all crews and a third assumption was that transportation and food costs were added for WFU III crews only.

Exhibit XIX-12
Alberta WFU costing per crew

	Daily cost	Training	Contract days	Food transport.	Total	Cost/crew day
WFU I	$2204	17684	62		154332	$2326
WFU II	$2683	19382	62		185728	$2834
WFU III	$1063	9182	62	1591	173730	$2641

Source: LFS

A similar costing was done for the MARS crews. The assumptions and relevant factors were as follows:

- The MARS crew rate is $350/day per person plus lodging and transport from the home base.
- The crew size is eight persons.
- The lodging, food and local transportation is $1,591/day.
- An estimated one-time transportation cost per crew is in the order of $6,000.
- As estimated from the CIFFC data, the crew assignment period is 15 days.

Given this data, the cost to Alberta of a single MARS crew per assignment was $71,865.00. The cost for a 15 day MARS crew assignment represents 46% of the cost of a full seasonal (62 day) WFU I crew, 39% of a full seasonal WFU II crew and 41% of a full seasonal WFU III crew.

Exhibit XIX-13
Cost per day comparison

	Alberta Local Crew	MARS crew
WFU I	$2,326	$4,791
WFU II	$2,834	$4,791
WFU III	$2,641	$4,791

In 1998, the equivalent of 259 crews were imported to Alberta at an approximate cost of $18.6 million, and in 1999, 90 crews at a cost of $6.5 million were imported. This total of $25.1 million is equivalent to 162 Alberta WFU crews for a full 62 day contract.

Although this data indicates that the MARS crews are substantially more costly than Alberta WFU's, it must be emphasized that it is good business to provide for peak firefighter needs from MARS. The question becomes one of where the inventory threshold should be established and whether it makes sense to transport the expensive MARS crews to do work that could be done by the WFU III inventory in Alberta. The high degree of movement of sustained action crews is possibly acting as a deterrent to the development of an effective WFU III program in Alberta.

A final note, CIFFC was not always able to provide all of the personnel requested, and often the receipt of the crews was delayed. This shortage may be due to two reasons:

- Other jurisdictions were also fully committed and not available.

- The national inventory of certified fire personnel is now too low in the country to meet annual fire season needs.

There seems to be no reasonable way of confirming these difficulties short of a comprehensive review of past and current firefighter and overhead inventories.

F. Conclusions

- Alberta is now a net recipient of resources under the MARS agreement.
- The strategic reserve for WFU I, II, and III crews is too low to meet any but the normal or below normal fire season. The availability of the WFU III sustained action crews is particularly problematic.
- Thresholds for crew inventories have not been established in policy.
- Importing sustained action crews may not be cost effective.
- The costs associated with importing MARS crews for a 15 day period is almost 50% of the cost of a full annual crew.
- WFU crew standards, in terms of persons per crew, are not followed in some Regions which impacts Alberta's ability to effectively utilize the MARS agreement. As well national crew standards are not in place. Certification of crews at both provincial and national levels is appropriate.
- The national inventory of firefighters may be at critically low levels as indicated by five year resource deployment data and experience.

G. Recommendations

48. Undertake a review of the WFU I and II crew requirements to meet Initial Attack and PPS need during peak demand periods. From this review, establish thresholds in policy that will be met by Alberta-based crews.

    Also as a matter of policy, LFS should provide for all of its needs for Sustained Action Crews internally.

49. Increase its WFU I and WFU II crew strength by at least 10% for year 2000. This addition would add four WFU I's and three WFU II's in the first year.

50. Immediately enhance the WFU III program and ensure that at least 3000 WFU III's can be mobilized. This enhancement will require adjusting the contract

terms and the input of additional funding to certify and develop the skill sets of these crews in their communities. The current review of the Firefighter Business Strategy will provide further guidance with this issue.

51. Develop incentives for the provision of Initial Attack crews in key areas of FMA's to supplement the provincial crew strength. A reduction in holding and protection charges will help in this regard.

52. Call on the Board of Directors of CIFFC sponsor a national study of crew standards and inventories to address the issue of sharing certified firefighters in a timely fashion under MARS in the year 2000 and beyond.

XX

Environmental Factors—Climate Change And Fire Regime

Factors such as fire regime (duration, frequency and intensity of forest fires for a given geographic region) and climate change can have a significant influence on both current and future forest protection expenditures. This implied relationship simply stated is that warmer and drier climatic trends contribute to longer and more intense fire seasons which, in turn, correlate to higher fire fighting costs. Although these linkages have been identified by members of the scientific community, the global warming debate still carries on with significant implications for government policy and industry regulations.

The purpose and benefit of a discussion on climate change is not found in further debate of either the linkage or the scientific basis of a cause-and-effect relationship between climate change and fire regime. What is valid and important to this review is a discussion around the observed trends over the past decade with respect to the timing and duration of fire seasons across Canada and what impact those trends have for future forest protection policy and expenditures.

A. Fire season length and readiness

Canadian fire management agencies, particularly in the regions north and west of central Ontario, sense that they have been experiencing serious fires earlier in the season and have been encountering seemingly longer and more intense fire seasons as time progresses. This perspective has been articulated across Canada by a number of fire managers and fire researchers through interviews and discussions.

Much work needs to be done in quantifying these largely subjective statements, however, there are observed sets of circumstances which can be argued as objective when taken at face value. Observations by the wildfire specialists participating in this review, coupled with confirmation from other practitioners of fire management programs in Alberta, British Columbia, Saskatchewan, and Northern Ontario, indicate that fire seasons are generally observed to be starting earlier and ending later. These observations are generally confirmed by long term staff of government and industry who suggest that 30 years ago, fire management organizations needed to be "ready" by May 15. During the last decade, it is apparent that readiness needs to be moved to approximately April 15, depending upon snow packs, early spring temperatures and spring rainfall.

Several factors are noted as possible contributors to this observed phenomena, including:

- Global warming.
- Increased detection capability.
- Increased forest access.
- Increases in fine fuels created by roads, energy transmission lines and industrial clearing.
- Agricultural encroachment.
- The growing wildland/urban interface.

Most fire managers across Canada believe that the issue of earlier, longer and more intense fire seasons is real. Quantifiable evidence and objectively based computer forecasts have been evaluated and consolidated in a paper prepared by B.M. Wotton and M.D. Flannigan (Appendix C). This information indicates that fire seasons are starting earlier and are lasting longer.

B. Conclusion

The reality of increased spring hazards caused by early drying of fine fuels, coupled with the reality of larger areas with these fuels, means that all fire agencies in northwestern Canada need to prepare earlier and sustain fire management activity later.

C. Recommendations

53. In partnership with the new "Climate Change Central" (created to study and manage the effects of increased levels of greenhouse gases in the atmosphere), the LFS should support on-going research which uses atmospheric circulation models to study the effects of greenhouse gases, such as carbon dioxide. This research will serve to more accurately record the effect of climate change on the forest and provide the basis for more accurate predictive forecasting of fire season length and intensity.

54. External to the debate on the relationship of greenhouses gases and climate change, the LFS and the Province should accept that forests are responding to a relative change in climate—despite whether this change is within natural climatic variability or not. These changes have had and will continue to have real impacts on the costs of forest protection and government needs to adapt their organizations and budgets to reflect an observed increase in the duration and intensity of fire seasons in Alberta over the past 30 years.

XXI

The Role Of Airtankers In Forest Fire Suppression

The goal of most urban or rural fire departments is to respond to the actual scene of the fire and take appropriate direct action within five to ten minutes of a fire report or discovery. Similar goals are often necessary of wildland fire fighters. The presence of road infrastructures in most urban or organized community settings allow their fire departments to meet this goal. On the other hand, most Canadian wildland fire agencies do not have the luxury of road access to large portions of their valuable and fire prone forest areas. To counteract this reality, Canadian (and other world fire agencies) have turned to aerial delivery of fire suppressants and fire fighting personnel. Thus fire bombing, through fixed-wing and rotary-wing aircraft, have become the de-facto "first responders" for wildland fire fighters nation wide.

The most effective aerial initial attack resources is the fixed-wing fire bombing aircraft (airtankers). A fixed-wing aircraft can reach the fire quickly, and can provide the necessary overwhelming suppressant agent to contain the fire. Once contained, helicopter borne "initial attack" crews can go to work on the ground and extinguish the fire. Fixed-wing fire bombing aircraft have several advantages. They have an ability to reach the fire quickly with large supplies of suppressant; they can work independently or in support of ground fire fighters; and they are highly mobile—allowing them to move rapidly between fires and with a minimum of preparation.

There are differences in opinions over the relative merits of using fixed or rotary-wing aircraft in the process of initial attack and sustained action on fires. Some proponents of rotary-wing aircraft insist that the helicopters can adequately handle the requirements of both rapid suppressant delivery, and delivery/support of ground personnel. Obviously there are conflicting challenges in the selection of aircraft for initial attack and support action on remote or larger wild fires. In modern fire fighting, there is access to a wide range of aircraft, each with it's own merits and drawbacks. Each is a tool in the site commander's arsenal, and selections regarding the appropriate response can only be made according to local and emerging on site situations.

The key in this discussion is recognition of the need, and commitment to providing reliable and effective fire bombing aircraft for that site commander to utilize in his response to emergency situations as they develop.

Air tanker use in Alberta

Alberta has been among the Canadian leaders in development of airtankers and has participated in national programs to acquire certain airtanker types such as the water based CL-215.

The Alberta airtanker development model has favored the development and management of the airtanker fleet by the private sector. A very successful partnership with companies such as Airspray Ltd. of Red Deer, Alberta, and Conair Aviation Ltd. of Abbottsford, B.C., have provided an effective fleet of piston powered land-based airtankers. The Alberta fleet consists of Douglas A-26 Invaders supplied by Airspray Ltd., DC-6 heavy fire bombers supplied by Conair Ltd., and a blend of provincially-owned and privately-owned CL-215 water scoopers—operated by Airspray Ltd.

Many of Alberta's land-based airtankers are nearing the end of their service life. Most predictions indicate little more than 10 years of viability remain for the majority of the piston powered fleet of A-26's, DC-6's and CL-215's. The primary issue here is the continued viability of the piston engines which power all of these aircraft. These engines were manufactured during World War II, and reliable parts supplies are more difficult to find and guarantee with each passing year. On the positive side, the engines which power the A-26 and CL-215 are very reliable. These engines still have excellent dispatch reliability—but the clock is ticking. The most immediate concern is the serviceability of the current DC-6 fleet. Increasing problems with engines and major component parts have reduced dispatch reliability in recent years, and have hastened the search for a more reliable heavy fire bomber.

In recognition of this serviceability issue, Airspray Ltd. have developed and introduced the Lockeed Electra, a four-engined turbine powered aircraft. This aircraft has a very high capacity and speed which could provide excellent "first responder" action to any area in Alberta. Conair Aviation Ltd. has recently developed a slightly smaller turbine powered heavy fire bomber—the Convair 580. This aircraft has an excellent service record in commercial aviation and is forecast to be available as a reliable aircraft into the foreseeable future. In addition, a smaller single engine turbine powered aircraft, the AT-802 is now in service and under trial. This aircraft is considered to be a "medium" fire bomber with an approximate 3200 litre capacity.

Alberta acquired four water scooping CL-215's as part of a national program to add more airtankers to the Canadian fleet. This national program provided a cost-shared arrangement wherein the provinces purchased aircraft, which were matched by the federal government. After 10 years of provincial ownership and management, the federally-owned aircraft were sold to the provinces for one dollar each and each province assumed ownership of all aircraft in the program. Alberta originally purchased two aircraft, which were matched by two supplied by the federal government. In 1998, Airspray Ltd. purchased an additional two aircraft from Canadair Ltd. Notably, these two aircraft became the only privately-owned CL-215's in the world.

In keeping with Alberta's support of private sector delivery of programs, the operation and maintenance of the provincially-owned aircraft were subcontracted to Airspray Ltd. in several long term contract arrangements. The Province has received excellent service delivery of fire bombing aircraft in return.

A particular issue respecting private sector operation of airtankers is related to the subject of ownership and management of the provincial fleet of CL-215's. The issue is that the provincial aircraft and support parts store is owned by the provincial Department of Infrastructure (D.I.). In the case of the privately-owned CL-215's, Airspray Ltd. negotiated a process which saw the province purchase some additional parts required for use on the slightly different CL-215 model bought by the company.

The original contract for operation and maintenance of the provincially-owned CL-215's included an arrangement for the subcontractor to manage and control the parts supply as part of the terms. This arrangement is a natural fit as Airspray Ltd. must operate an "approved" maintenance facility as part of it's operating license, and must conform to strict Federal Ministry of Transport guidelines for internal management of parts. The company is subjected to periodic audits to ensure strict compliance.

With the acquisition of new parts, the D.I. did not turn them over to the company to manage as before, but decided to manage their own parts within their own organization. To facilitate this, the D.I. hired and installed a parts manager in the Airspray Ltd. facility. Now Airspray must purchase parts for their privately-owned airplanes from the government parts manager. In reality, there are now two government parts stores located within one private sector facility—requiring duplicate management (one government and one private).

Conclusions

The agency which utilizes the aircraft (the LFS) is dealing through a third party (Department of Infrastructure), and is paying fees for service—in order to manage the fleet. Negotiation of arrangements for management and service delivery, must also be facilitated through the Department of Infrastructure representative. The mandate of the Department of Infrastructure need not extend beyond the purchase and subsequent financing arrangements particular to the Province of Alberta's accounting practices and policies.

In this case, the Department of Infrastructure appears to have properly fulfilled it's mandate and responsibility by purchasing the aircraft and new aircraft parts. The insertion of a third party between the user of the service (the LFS) and the contractor seems to be an unnecessary extra and expensive process which is not in tune with efficient and effective private sector delivery of government services.

The Department of Infrastructure could transfer nominal ownership of aircraft and parts to the Alberta Lands and Forest Service for management and control

of this important provincial asset. Such a transfer would eliminate the Department of Infrastructure "middle man", thereby reducing the cost of management by a minimum of $150,000.00+ (under review). This transfer would also eliminate the need for duplication of efforts in parts management, and contract negotiation.

Recommendations

55. Support the continued development of a turbine powered fire bomber fleet to ensure orderly and timely conversion to more modern aircraft types.

56. Consider transferring management of provincially-owned aircraft and parts from the new department of Alberta infrastructure to the Lands and Forest Service, thereby eliminating duplication of administration.

XXII

Communications, Continuous Improvement And Performance Measures

A. Communications

Issues with communications and the effectiveness of the Forest Protection Program have largely been dealt with in Part I. There are additional issues, however that relate to the broader policy perspective of the Forest Protection Program. These communications issues arise primarily from two areas:

- Communications within the Forest Service related to the relationship between forest areas and regional Forest Protection staff.
- Communications at the local level between Forest Protection staff and public stakeholders, particularly Aboriginal communities.

1. Internal communications

Issues respecting communications within the Forest Service have been raised by both forest area staff and regional staff in the context of accountability and responsibility. In the organizational model adopted immediately after the 1998 fire season, regional forest protection staff were to handle all initial attack functions and were responsible for the success or failure of containing the fire within the first burning period. Should initial attack efforts not be successful in containing a fire within the first burning period, the responsibility for sustained action on that fire was then handed off to the forest area.

Communication is critical to the Forest Area manager and Forest Area protection staff as escaped fires are handed off to them. While a formal reporting and communication structure was designed and implemented to ensure communications take place between all parties involved in fire suppression activities, it is a difficult task to accomplish when fire activity is very high and human resources are stretched to the limit.

Communications internal to an organization are largely a function of organizational structure, lines of accountability and supervision, and specific communication protocols established within a reporting structure.

Internal communications concerns reported during interviews focused primarily on the transition from escaped initial attack to sustained action. On a number of occasions information was not readily available to the Forest Area as fires were handed off to them—information that was critical for resource acquisition and deployment. In addition, information about the fire (i.e. fuel types, fire behaviour, etc.) was not quickly available, and this prevented the Forest Area or overhead team from developing optimal strategies and actioning the escaped fire immediately. The result was, in some cases, a delay of a day or two in actioning escaped fires—a consequence of a number of issues, including communications.

The recommended changes to the forest protection organization and structure largely resolves these issues. Establishing clear lines of accountability, responsibility and command and control functions largely represents an improved communications framework for forest protection staff. By having the same individuals or groups of individuals responsible for pre-suppression, initial attack and sustained action on all wildfires, the difficulty in maintaining communications between groups with different interests and responsibilities is overcome. We feel that this single change will not only enhance internal communications related to initial attack and fire suppression, but it will also lead to increased opportunities to share information across the province respecting different fire status and other matters of interest.

One possible drawback of an organizational alternative that involves a dedicated fire organization is the maintenance of communications between Forest Protection staff and other Land and Forest staff. While the concern addressed in 1998 related to communication among individuals involved in forest protection, it is also important to consider the need for communication between forest protection staff and those involved in other aspects of the Land and Forest Service's mandate. In order to deal with this potential issue proactively, the LFS must make a concerted effort to keep the whole organization up-to-date with respect to fire status and occurrence by ensuring that all staff are aware of the sources of this information (i.e. internet website and daily briefings).

In addition to communicating for the purposes of actioning fires, it is also important to communicate throughout the organization about policies and procedures. The LFS has an extensive system of communicating policies and procedures through hard copy distribution of directives, internal and external website postings, E Mail and spring and fall forest protection conferences and meetings. These various methods of communicating are certainly adequate and meets the needs of the LFS in terms of forest protection policies.

2. External communications

External communications issues relate primarily to relationships between the Land and Forest Service and both public stakeholders and forest products companies. These communication issues have been discussed in Part I of the review. External communications issues are further dealt with through a reorganization or restructuring of the forest protection program as staff are added to the program at the local level.

New forest protection staff added at the local level would be assigned the specific responsibility of enhancing communications and working relationships between the LFS and its key stakeholders, such as the forest industry and Aboriginal Communities. In addition, the following support and initiatives already undertaken by the LFS will help improve external communication issues:

- Continued support for the Alberta Forest Protection Advisory Committee.
- Continued support for the Forest Industry Sub-committee.
- Establishment of an Aboriginal Community Sub-committee.
- Continued use of the forest protection website for information dissemination.
- Expanded use of forest industry liaison contract positions.

B. Continuous improvement

Efforts to continuously improve performance is an attribute of most successful companies and organizations and the formal presence of a continuous improvement program could be considered a "best practice" characteristic. The Forest Protection branch currently has in place a continuous improvement program that is aimed at improving the program in a number of areas identified by management and outside stakeholders. This program has been active since 1996. While the current continuous improvement program is certainly helping to enhance the forest protection in Alberta, it is based on a specific number of problem areas or opportunities for improvement that have already been identified—there is no formal structure to help perpetuate the practice in the future.

Continuous improvement and quality management have long been a subject of study and effort for organizations since the late 1980s. Continuous improvement in the private sector helps to create steady growth and enhanced profitability. In the public sector, the practice is carried out in much the same way and is typically looked at for enhanced program quality and cost control objectives. Whether implemented in the private or public

sector, continuous improvement works best when it is designed to help the organization keep a focus on its key goals and objectives.

Overall there are a number of key points that need to be considered when developing a continuous improvement plan. Fifteen elements of continuous improvement are:

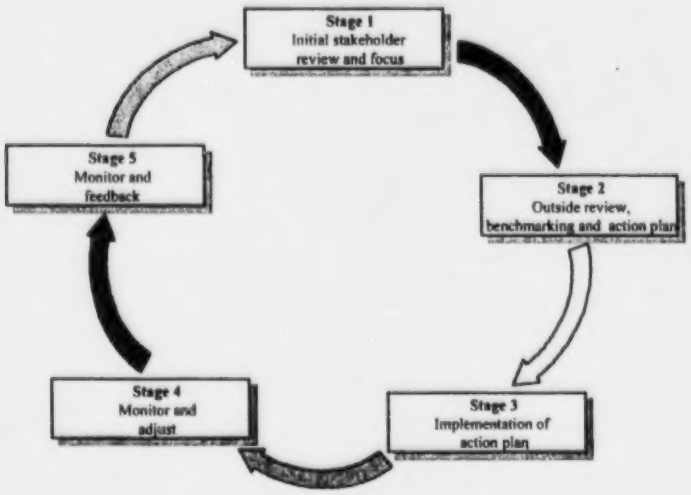
- Continuous means ongoing—the process never stops.
- Have a formal suggestion system for your employees.
- Make certain your improvements involve your stakeholders. This means getting regular feedback on how you are performing and what your customers want and need.
- Do not try to do it all at once—set up a plan and do it in stages.
- Try to work on two or three top priorities at one-time—working on more than that can diffuse effort, energy and resources.
- Do the simple and cheap things first and quickly—this builds credibility, momentum and commitment with your people.
- Acknowledge and reward accomplishment—this creates a positive environment for improvement and promotes employee participation.
- Bring up continuous improvement issues and accomplishments regularly in business meetings.
- Continually look for breakthrough improvements—focus on delivering increased value and effectiveness.
- Develop a continuous improvement system that works for your business—do not copy others without trying to create a proper fit.
- Look inside your sector at your sister organizations and their best practices—your colleagues can often show you a better way.
- Look outside your sector to see what other organizations are doing—there may be more improvement ideas outside your sector than inside it.
- Once a year have an outsider review your business or part of your business. Outsiders can often see what you cannot.
- Use a cost benefit analysis—if you have difficulty setting priorities tackle those that give you the greatest benefit for the least cost first.
- Be hungry for new ideas in ways to improve—make this a part of your business culture.

Continuous improvement can either be a positive part of an organization's culture or can be viewed as an unwanted administrative task poorly accepted by employees. The first most important aspect of implementing a continuous improvement program is to empower your staff to participate in the process and to make recommendations for improvement. Empowering individuals in the organization usually promotes creativity and thought in the organization and builds commitment to delivering quality in everyday service. When employees are empowered to participate in continuous improvement there is typically an atmosphere of trust and respect. The advantage to employees is a greater feeling of control over their destinies and greater level of job satisfaction. Advantages or benefits to management or leaders within an organization is an overall increase in power and influence as empowerment generally increases the organization's ability to make things happen.

The greatest detriment to continuous improvement is an "I" culture as opposed to a "we" culture. An "I" culture supports the most damaging myth that the individual is more important or more influential than the team as a whole. This approach is particularly damaging to organizations that are in transition or meeting challenges requiring change. Empowerment, employee support and stakeholder satisfaction are all better accomplished when the team as a whole is working together towards its objectives rather than having individuals strive for personal gain.

Using the 15 elements of continuous improvement as a guide and considering the nature of the Land and Forest Service and the Forest Protection Continuous Improvement Program already in place, a continuous improvement program is recommended as described in Exhibit XXII-1.

Exhibit XXII-1
Continuous improvement program



The continuous improvement program depicted in Exhibit XXII-1 is intended to be applied to the four disciplines of the forest protection program over a cycle of five years. Each discipline would start the continuous improvement cycle at Stage one in different years. Given the complexity and attention of the *fire suppression* discipline, it could be split into two sub-disciplines, such as air operations and ground operations.

With this cyclical approach to continuous improvement, each discipline of the protection program will be at different stages of review at any given time. All the stages will be in progress in each year, for the various disciplines. Exhibit XXII-2 is an example of how this continuous improvement program might be applied in any given year, with fire suppression split into two general areas.

Exhibit XXII-2
Applying the continuous improvement program

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Year 1	Detection	Prevention	Pre-suppression	Suppression—air operations	Suppression—ground operations
	Initial review and focus	*Outside review, benchmarking and action plan*	*Implementation of action plan*	*Monitor and adjust*	*Monitor and feedback*
Year 2	Suppression—ground operations	Detection	Prevention	Pre-suppression	Suppression—air operations
	Stakeholder and staff review and focus	*Outside review, benchmarking and action plan*	*Implementation of action plan*	*Monitor and adjust*	*Monitor and feedback*

Additional details on the elements of the review within each stage are provided as follows:

Stage 1: Initial stakeholder review and focus

- Feedback is solicited from staff and stakeholders regarding issues and concerns with respect to the discipline being considered.
- Opportunities for improvement are identified and confirmed with staff and stakeholders.
- Key or critical opportunities are identified to help focus the improvement initiatives.
- Opportunities for quick/easy improvements are identified and immediately acted upon.

Deliverable

Report outlining issues and concerns, opportunities for improvement, opportunities to be focused on and quick win improvements.

Stage 2: Outside review, benchmarking and action plan

- An outside review, by fire management experts in other jurisdiction or by some other objective reviewer, is carried out for key opportunities identified in stage 1.
- Benchmarking or best practice comparison is carried out for the business area affected by the opportunity.

- An action plan is developed that addressed changes or improvements to the business area of focus. Performance measures and targets for each initiative are developed

Deliverable

Action plan for improving specific practices or elements of the forest protection discipline being reviewed.

Stage 3: Implementation of the action plan

- An individual is charged with implementing the action plan.
- An individual team would be accountable to the change manager for implementing the action plan.

Stage 4: Monitoring and adjusting

- The year after the action plan changes are implemented, the changes are monitored closely and adjustments made as required.
- Actual performance is assessed against performance measures and targets.

Stage 5: Monitoring and feedback

- The second year after changes are made, the business unit is monitored and any feedback is documented and used for the next stage, initial stakeholder review and focus.
- Performance measures/targets are used to evaluate the success of the initiative.

C. Performance measures

The Land and Forest Service maintains a business plan for the division which addresses goals, strategies and performance targets for its main areas of responsibility. Performance targets address the four disciplines and expectations in each of these areas. Performance targets currently established are presented in Exhibit XXII-3.

Exhibit XXII-3
Performance measures

	Prevention	Detection	Pre-suppression	Suppression
Performance Measures	• Maintain the number of person caused fires in the Forest Protection Area at 0.18 fires per person residing in the province.	• Detection of 100% of wildfires at a size of 0.1 hectares or less.	• 100% of successfully detected wildfires actioned before reaching 1.2 hectares in size.	• 100% of fires held before the second burning period. • Annual burn area kept below 1/10 of 1% of the land under protection.

These five performance measures have proven effective in guiding the forest protection program in the past and are more or less consistent with performance measures used in other jurisdictions. Recently, the province of British Columbia has changed the way in which it delivers forest protection and has created a special operating agency as its forest protection agency. The special operating agency (British Columbia Wildland Fire Service, BCWFS) has established additional commitments and performance measures in its business plan including:

- Maximum members of human caused forest fires (1,168).
- Percentage of wildfires contained under four hectares (94%).
- Percentage of fires responded to within target (96%).
- Area burned over five years (150,000 ha).
- Value of timber lost over five years.

Using some of the "state of the art" performance measures recently established in British Columbia and considering some of the issues unique or important in Alberta, performance measures should be developed or improved as follows:

1. Prevention

- Maintain the current performance measure, for the rate of human caused fires. Consider targeting a decrease in human caused fires over time.

2. Detection

- Maintain the current performance measure for detection size.

- Add a performance measure regarding the percentage of fires detected at a size that did not meet the stated objective and relate various measures to different hazard ratings or initial spread indices.

3. Pre-suppression

- Maintain the current performance measure for initial attack.

- Add a performance measure regarding the degree to which the pre-suppression and preparedness plan is satisfied. The measure may relate to the number of times and degree to which the plan is not fully implemented due to resource constraints or other issues (after adjusting for management decisions strategically altering the plan in response to new information).

4. Suppression

- Maintain the current performance measure for controlling wildfires but recognize the likelihood of not being able to meet a 100% success rate objective during all fire seasons.

- Maintain the current performance measure for annual burn rates, but express this on a five year rolling average.

- Add a performance measure related to the economic value lost over a five year period of time. This measure can relate to the value of standing timber, property, infrastructure and other values.

- Add a performance measure related to the impact on annual allowable cuts in the province.

5. Program wide

- Add a performance measure related to the level of expenditures over a five year period of time. This will help to promote fiscal restraint in low fire seasons in an effort to meet five year performance targets. Spending targets should be linked to the funding level available from the Environmental Protection Emergency Fund.

D. Summary of recommendations

In addition to maintaining current performance measures, the following should be enhanced or developed for the Forest Protection Program.

- Prevention performance measures should target a decrease in the number of human caused fires per capita.

- Detection performance measures should target a maximum rate of "detection objectives not met" under different fire hazards and/or initial spread indices.

- Pre-suppression performance measures should measure the extent to which the provincial pre-suppression/preparedness plan is satisfied.

- Suppression performance measures should address economic values lost and annual allowable cut impacts over a five year period of time.

- Five year spending targets should be established for forest protection, and these targets should be linked to the Environmental Protection Emergency Fund.

XXIII

Forest Protection Agreements

The Forest Protection Area (FPA) in Alberta is established by Order—in council, and defines the area within the province which is protected by the lands and Forest Service (LFS). These lands are re-defined from time to time under the Forest and Prairie Protection Act, Chapter F-14, Revised Statutes of Alberta Regulations 414/83, and total approximately 38,523,607 hectares (95,190,528 acres). Within this area, the LFS accepts and assumes total responsibility for all forest protection programs.

Definition of areas which are "outside" the FPA involves consideration of the reality of the jurisdictions which are located immediately adjacent to, or are totally surrounded by the FPA. For example, many municipalities encompass large tracts of land which are effectively wildland and pose hazards to people, property and natural resources which are similar to defined forest areas within the FPA. Additionally, Alberta has internal and external neighbors such as other Provinces and Territories, National Parks, First Nations reserves, and the Department of National Defense.

A third level of administration or activity exists in the establishment of industrial sites such as pulp mills or sawmills, power and gas utilities, and transmission lines within the FPA. Often such activity increases fire hazards by opening up or creating easy forest access for more people, or creating an increased amount of fine fuel such as grasses or logging slash.

The issue for the LFS is the obvious necessity for reaching agreement with all of these forest-based entities to prevent, prepare for, and suppress wildfires within their adjacent lands. A number of forest protection agreement types have been reviewed, including:

- Municipal Districts and Counties.
- Neighbouring provinces.
- Federal government.
- Forest products firms.

A. Agreements with MDs and Counties

Responsibility for fire protection programs outside of the FPA but within an MD or County rests with associated urban or rural municipalities. In order to facilitate and allow for appropriate action and programming, both the LFS and municipalities are bound by the Forest and Prairie Protection Act. A complimentary section (75) in the Municipal Government Act speaks to this issue as well.

A wildfire does not respect any geographical or political boundaries. The area where development and wildland fuels meet is called the Wildland/Urban Interface. This definition applies to all community and industrial areas. In these situations, a significant fire risk to public safety, homes, industrial development, and natural resources results whenever development is mixed with wildland forested areas. This is an escalating global issue which continues to challenge emergency service agencies, resource managers, urban planners and fire fighters. Rapid urban and industrial expansion and the desire by many people to find more living space and privacy (including those who seek a "back to nature" experience) combine to add to fire risk in the interface.

An LFS background paper which established the terms of reference for the Alberta Association of Municipal Districts and Counties (AADMC) and the LFS states in part, "There is concern over the drain of LFS resources and equipment from the Forest Protection Area to areas within counties and municipalities and the associated impact upon the mandated responsibility of the Land and Forest Service". The interview and research phase of this study revealed that the LFS actioned 47 wildfires outside the FPA at the request of municipalities or by prior action agreements during the 1998 fire season. These activities utilized 403 personnel, 28 helicopters and 10 air tanker groups. There is some evidence gained from interviews of LFS staff and industry representatives that some of these actions contributed to the escape of wildfires in the FPA.

The LFS cannot be faulted for reacting favorably to requests for assistance by municipalities. The reality is that LFS fire management policies have historically defined priorities in order of human life, property and resources. This is a long established and accepted position and is not unlike those priorities established by other Canadian and International fire agencies. Protecting human life has always been the number one priority, and most certainly will be the number one priority as long as public services deliver fire protection programs. The point here is that, on occasion, the Provincial fire management organization must provide some assistance in times of real need. In these instances, all levels of government must recognize that commitments of this nature may result in losses in other areas.

In Alberta, many stakeholders have realized that hazard reduction, silvicultural prescriptions, public awareness, and co-operative programs will go a long way toward mitigating some of the problems. In recognition of this, programs such as Partners in Protection have been instituted. The LFS also analyses the applicability of other national and international programs, and participates in international groups such as the

Wildland/Urban Interface Consultative Group. The goals of these programs focus on collective approaches to reducing risk, educating communities, and co-ordinating efforts and resources.

In reviewing the "template" developed by the LFS as a basis for formalizing agreements with Municipal Districts and Counties, two principles must be emphasized:

- Communities and stakeholders must recognize and accept their legislated and negotiated responsibilities with respect to Wildland forest protection.

- Communities and stakeholders need to develop principled understandings and commitments which recognize and define their legislated, mandated or negotiated responsibilities.

The "template" agreement for MDs and Counties is an excellent start. The only issue remaining is the full acceptance of these negotiated responsibilities and administrative arrangements.

B. Agreements with the Federal Government

Fire control agreements between the province and federal government exist for Indian Reserves, the Cold Lake Air Weapons range and the national parks. Agreements for all of these federal land holdings are different, as the federal government has different protection objectives for each area.

Agreements between the province and federal government have been reviewed and appear to be clear and effective. There have been no cases raised in the course of the review to indicate that the agreements were not effective. Essentially, the province is delegated the responsibility of providing full protection in the air weapons range and on Indian Reserves, with charge back arrangements fair and effective.

C. Agreements with bordering provinces

The Land and Forest Service also has agreements with its neighbouring provinces and territory—Saskatchewan, British Columbia and Northwest Territories. These agreements reflect the practical need to allow any of the jurisdictions to action fires in the other provinces and territory within a certain distance of the border.

A review of these agreements and how they are applied indicates no significant policy issue. All parties have clear levels of authority and responsibility regarding actioning fires and reimbursing costs—no charge is needed in this area of working relationship.

D. Agreements with forest products firms

A review of fire control agreements with forest products firms, particularly Forest management Agreement holders, indicates a system that is working well. The fire control agreement requires the firm to provide for a certain level of training among its woodlands workers, a certain level of equipment and supplies and established procedures for action in the event of a forest fire in the area. In addition, the fire control plan establishes protocols for cooperation and resource sharing where it is practical to do so.

There has been some support for elevating the role of the forest protection agreement between the Crown and FMA holders where both are in agreement. The fire control agreement is an excellent vehicle for promoting increased participation in the protection program by defining those activities that are required of the company and those that are optional. Optional initiatives may be those that are eligible for a reduction in holding and protection charges, should such an arrangement be approved by government.

One specific issue that arose while researching the effectiveness of fire control agreements was the level of protection against liability afforded the firms within the various agreements. Within fire control agreements, FMA holders have a limitation of liability for damage caused by controlled burns that escape, provided the controlled burns were carried under the approval of the LFS. Quota holders have no such limitation of liability and are therefore reluctant to carry out any form of prescribed burning for slash disposal or other purposes. This issue has not yet been resolved, but is clearly preventing some quota holders from taking a more active part in fire management.

E. Other issues respecting fire control agreements

In addition to the assessment of fire control agreements, two other matters arose that deserve some attention. First is the apparent willingness of other industry sectors to enter into fire control agreements. The energy industry in particular has expressed interest in participating in fire control agreements. Some oil/gas companies operating within the FPA have willingly entered into agreements with the LFS entirely through local discussions. The agreements specify tool and equipment availability, personnel training and procedures to follow should the energy company be the first responder to a wildfire. A continued effort to development these fire control agreements with energy industry firms operating within the FPA would be a very positive direction. It is not feasible to make these agreements mandatory for all firms nor standardized due to the wide range of firms operating in any given area from year to year.

The second matter that was reviewed is the work of the Forest Industry Sub Committee in defining activities that would be eligible for reducing company holding and protection charges. It has been proposed that these charges could be reduced if firms carry out activities that either add to the prevention of forest fires or that add to the capability of the province to action wildfires. These activities are being very carefully identified to ensure

that the purpose of the holding and protection charge continues to be met, but in new and innovative ways.

F. Conclusion

Acceptance is the key to development of agreements between adjacent parties in areas where more than one party has forest protection responsibilities. Agreements cannot be realistically developed unless there is recognition and genuine acceptance of responsibility by all stakeholders located within or adjacent to Alberta's Forest Protection Area.

Once recognition and acceptance of responsibility is achieved, the development of appropriate agreements can be a relatively simple process. Agreements should contain:

- Identification of parties to the agreement and descriptions of relative responsibilities.
- Identification of responsible and supporting officers within the agreement.
- Statement of intent with regard to specific action to be taken respecting prevention, detection, pre-suppression, and suppression.
- A "first action clause" to identify responsibility for initial action on any fire occurrence within accepted responsibility areas.
- Definition and acceptance of financial liabilities for payment for prevention and suppression processes.
- Identification of and prior agreement for special or unique situations identified by either party to the agreement.

The current agreements have all of this information within the current wording and they appear to be working effectively.

Appendix A
Interviewees

Interviewees

Individual	Organization
Kelly O'Shea	Land and Forest Service
Bill Beraska	Land and Forest Service
Dennis Quintilio	Land and Forest Service
Hugh Boyd	Land and Forest Service
Russ Stashko	Natural Resource Service
Gord Graham	Land and Forest Service
Corp. Pat Casey	RCMP
Cliff Henderson	Land and Forest Service
Dean Bradford	Whitecourt, Alberta
Norm Denney	Weyerhaeuser Canada Ltd.
Russell Stashko	Natural Resource Service
Jim Skrenek	Environmental Protection
Al Westhaver	Parks Canada
Ken Brands	Hinton, Alberta
Butch Schoenfield	Land and Forest Service
Keith Branter	Sunpine Forest Products Ltd.
Peter Smyl	MD of Woodlands
Ron Jackson	County of Athabasca
Keith Brand	Hinton, Alberta
Greg Neil	Sunpine Forest Products Ltd.
Darryl Rollings	Land and Forest Service
Craig Quintilio	Land and Forest Service
Peter Moore	Alberta Treasury
Bruce Perry	Land and Forest Service
Representative	Canadian Helicopters
Representative	Delta Helicopters
Representative	PTI Caterers
Paul Driedger	MD of McKenzie
Representative	RailLink
Chief James Ahnassay	North Peace Tribal Council
Ron Henriet	North Peace Tribal Council
Jim Web	North Peace Tribal Council
Ty Lund	Dept. of Agriculture, Food and Rural Development
Gary Mar	Dept. of Environment
Ivan Strong	Legislative Assembly
Doug Radke	Dept. of Environment
Howard Gray	Dept of Resource Development

Individual	Organization
Cliff Henderson	Alberta Lands and Forest Service
Kelley O'Shea	Alberta Lands and Forest Service
Bill Bereska	Alberta Lands and Forest Service
Dennis Driscol	Alberta Lands and Forest Service
Hugh Boyd	Alberta Lands and Forest Service
Cordy Tymstra	Alberta Lands and Forest Service
Revie Lieskovsky	Alberta Lands and Forest Service
Nick Nimchuk	Alberta Lands and Forest Service
Bob Young	Alberta Lands and Forest Service
James McQuarrie	Alberta Lands and Forest Service
Andy Masiuk	Alberta Lands and Forest Service
Jon Dillon	Alberta Public Works Supply and Services
Murdoch Carrier	Sask. Environment and Resource Management
Al Wilcox	Sask. Environment and Resource Management
Mike Flannigan	NFRC
Bill de Groot	NFRC
Cliff Smith	Forest Consultant
Rick Pedersen	Conair Aviation
Chief Bernie Meeneen	North Peace Tribal Council
Jim Badger	Treaty 8 Environmental Secretariat
Larry Hiller	NPTC
Michael Stern	NPTC
Ron Harrison	Metis Nation of Alberta

Groups—organization	Representatives
Land and Forest Service - PFFC	Nick Nimchuk Jaimie McQuarrie Bob Young Cordy Tytmstra
Land and Forest Service - PFFC	Dennis Driscol Revie Leivskowski Kurt Frederick Hugh Boyd
Blue Ridge Lumber Ltd.	Murray Summers Brian MacDonald Colin Scott
Millar Western Forest Products Ltd.	Trevor Wakelin Mark Coolen Doug Scatchard
Alberta Newsprint Company	Jim McCammon Marion Cowan Conrad Gray
Tolko / Buchanan	Dave Knight Donald Hume John Broderick
Vanderwell Contractors Ltd.	Darryl Mackay Don Dermott Lou Foley
Town of Swan Hills	Brad Watson Tim Ainscough Fire Chief
Slave Lake Pulp / Zeidler Forest Industries Ltd. / Weyerhaeuser Canada Ltd. / Vanderwell Contractors Ltd.	Gord Sanders Bert Laroque Lou Foley Ian Whitby Terry Kristoff
Land and Forest Service – Slave Lake	Al Hovan Jim Lunn Dale Thomas Henri Soulodre
Sundance Forest Industries Ltd.	John Huey
Weyerhaeuser – Edson	Tom Varty
Land and Forest Service – High Level	Kevin Frehill Bob Petit Gordon Nome
Manning Diversified Forest Products Ltd.	Steve Blanton Clarence Budl
Land and Forest Service—High Prairie	Two representatives
High Level Forest Products Ltd.	Tom Hoffman Richard Chemago Tim Gautier
Land and Forest Service – Edson	Dennis Cox

Groups—organization	Representatives
	Bruce Cartwright Ray Losson Colin Williams
Environmental Training Centre	Don Podlubny Terry Van Nest Rob Thorburn One other representative
Welwood of Canada Ltd.	Warren Kerr Two others
Mostowich Lumber Ltd.	Ron Mostowich Glen Larson One other representative
Whitecourt Energy Industry	Bill Karek (Nova / TransCanada) Larry Pletz (Federated) Bob Rock (Pengrowth) Wally Bauer (Mobil) John Hogue (Aerial Recon)
Slave Lake Energy Industry	Scott Davidson (Amoco) Bill Spiller (Anderson) Bill Crossman (Anderson) Garry Scott (Nova) Duncan Fisk (Chevron) Malcom McCown (Rainbow)
Weyerhaeuser of Canada Ltd. / Ainsworth Lumber Ltd. / Canadian Forest Products Ltd.	Bruce Schnieder Grant Williamson Peter Blake
Auditor General	Ken Hoffman Michael Stratford Stu Orr Two other representatives
Disaster Services	David Noble Marion Boon
Airspray Ltd.	Two representatives
Land and Forest Service -- Manning	John Brewer Doug Smith
Alberta Pacific Forest Industries	Don Pope
Landscape Management Focus Group	Doug Walker Daryl D'Amico Don Pope Ian Whitby Kelvin Hirsch

Appendix B

CIFFC National Resource Order Summary

CIFFC national resource order summaries

	Agency shippers													Agency receivers											
Year	BC	AB	YT	NT	SK	MB	ON	QC	NB	NS	PE	NF	*Other	Total	BC	AB	YT	NT	SK	MB	ON	QC	NB	NS	PE	NF	Other	**Total
1994	13	15	1	6	5	9	13	4	0	0	0	0	4	70	22	0	4	19	3	2	0	0	1	0	0	0	14	65
1995	32	20	8	7	8	18	16	13	5	5	1	9	48	190	1	5	10	4	28	5	72	43	3	0	0	0	4	175
1996	26	30	0	7	13	9	3	1	2	4	0	5	13	113	1	0	12	3	1	0	37	27	3	0	1	0	16	107
1997	12	15	0	5	6	0	0	4	2	0	0	2	6	50	1	0	2	0	1	1	31	11	0	1	0	0	2	50
1998	39	4	3	20	11	29	34	21	3	1	0	2	27	194	26	67	19	7	31	1	18	1	0	0	0	0	8	178
1999	53	13	0	13	11	12	15	9	2	0	0	1	7	136	0	36	41	4	3	7	23	0	2	1	0	2	1	120

Source: Canadian Interagency Forest Fire Centre.

** Other—have been grouped—includes Parks Canada, NICC, DIAND, NEFPC, CIFFC*

***Shipment and receiver orders do not always balance—some orders combined or filled by more than one shipper.*

Appendix C

Climatic Influences on Fire Season

Length of the Fire Season in a Changing Climate by B.M. Wotton and M.D. Flannigan

Length of the fire season in a changing climate

by B.M. Wotton and M.D. Flannigan[1]

The Canadian Climate Centre's General Circulation Model provides two 10-year data sets of simulated daily weather for a large array of gridpoints across North America. A subset of this data, comprised of only those points within the forested part of Canada, was selected for study. Fire season length was calculated from data sets of both the $1\times CO_2$ and $2\times CO_2$ runs of the model as well as for the actual climate, using observed data from weather stations. A comparison made between the results of the $1\times CO_2$ and $2\times CO_2$ runs indicated a significantly longer fire season across the country under a doubling of atmospheric CO_2 levels. Implications of this result, such as a fall fire season in Canada's east and greater strains on management agencies, are discussed.

Le Modèle de circulation générale du Centre climatique canadien fournit deux séries de données réparties sur dix ans qui simulent la température quotidienne d'un grand ensemble de points répartis sur un réseau couvrant l'Amérique du Nord. Un sous-ensemble de ces points, représentant seulement les points faisant partie du territoire forestier du Canada, a été sélectionné pour fins d'étude. La durée de la saison de feux a été calculée à partir des données simulant une fois le taux de CO_2 et deux fois le taux de CO_2, ainsi que pour le climat actuel, en utilisant les données recueillies à partir des stations météorologiques. Une comparaison établie entre une fois le taux de CO_2 et deux fois le taux a démontré une saison de feux significativement plus longue partout au pays lorsque le taux de CO_2 atmosphérique est doublé. Les implications de ce résultat, à savoir par exemple la saison de feux à l'automne dans l'est du Canada et les plus grandes pressions exercées sur les organismes de lutte, sont discutées

Introduction

Speculation abounds over the potential impacts of so-called greenhouse warming. The problem in making quantitative statements about this subject is the enormous complexity of the system involved. Indeed, we would need a spare biosphere with which to experiment in order to obtain accurate quantitative results. However, because we do need information about what might happen under a doubling of greenhouse gas levels in the atmosphere, we can do the next best thing, model the biosphere with powerful computers. These numerical simulations involve complex mathematical equations describing global circulation patterns and processes. First, a general circulation model (GCM) is built to match present day conditions as best as possible, and then the amount of carbon dioxide in the model's atmosphere is effectively doubled. This effective doubling of the concentration of carbon dioxide in the atmosphere is expected to happen by the year 2040. Carbon dioxide (CO_2) is the main greenhouse gas (in volume) being added to the atmosphere, but other gases such as methane, chlorofluorocarbons (CFS's) and water vapour also play a large role in contributing to the greenhouse effect. The results of this new run, called a $2\times CO_2$ scenario, are then debated as to their relevance and validity.

What could rapid climate change mean to the forest? A several degree Celsius rise in average global temperature is predicted by most models However, regional and seasonal changes in climate could be much more dramatic. With respect to forest fires, this temperature rise could, if there is no accompanying increase in rainfall amount, lead to a much drier forest, one in which fire ignition is easier and fire control becomes more difficult. Overpeck *et al.* (1990) predicted that global warming will cause weather conditions to be more conducive to forest fire occurrence through an increase in the frequency of "disturbance weather" such as summer/autumn drought and thunderstorms. Flannigan and Van Wagner (1991) used the output from three GCM's to suggest a nearly 50% increase in the area burned by forest fires in Canada in a $2\times CO_2$ world. Their study did not consider the lengthening of the fire season, however. In this regard, Street (1989), in a study of the effect of climate change on the Ontario forest fire situation, suggests that the fire season will become longer and that there will be a shift in the severe fire months to later in the season. This shift in the fire season is due to an expected increase in precipitation in the spring months and a decrease in the later summer months. The purpose of the present study was to look at the change in fire season length quantitatively in a $2\times CO_2$ world and to discuss the implications of these changes for fire management in Canada.

Data and Methods

The numerical climate change information used in this study was from a GCM running at the Canadian Climate Centre (McFarlane *et al.* 1991). The Centre's present model can provide monthly or daily data sets containing averages or samples of many different familiar climatic variables such as temperature, precipitation, etc. These data sets span 10-year periods and exist for both a $1\times CO_2$ and $2\times CO_2$ run of the model. They contain data from an array of 570 gridpoints covering North America (Figure 1).

We used a subset of the North American daily data set for this study, consisting only of gridpoints falling within the forested region of Canada. This amounted to only 61 gridpoints. To attempt to verify that the GCM was describing present weather patterns adequately, daily weather records were obtained from 41 Atmospheric Environment Service weather stations across Canada. These records spanned a period of 30 years from 1960 to 1989; station locations are listed in the Appendix.

When examining the output of GCM for effects caused by CO_2 doubling, note that many compromises and uncertainties are present in the model. Simulations must be kept

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computationally feasible and thus, simplified models of such processes as the role of heat transport within the oceans and the reflectivity of sea ice and cloud cover, to name a few, must be used. The spatial resolution of the models is also a limiting factor in keeping simulations at a reasonable level of computational complexity, and this can make regional simulation of climate change effects very uncertain (Grotch 1988). Also, processes such as SO_2 blocking as suggested by Charlson *et al.* (1992) are not included in simulations but may play a large role in determining just how fast and to what degree temperature may change in response to increased CO_2 in the atmosphere.

The first task, before any analysis of the data could proceed, was to devise a workable definition of fire season length. The start of the weather recording season is defined in the Canadian Forest Fire Danger Rating System (CFFDRS) (Canadian Forestry Service 1987) as beginning after: (1) three consecutive days of noon temperatures greater than 12°C for areas with no snow cover or (2) three consecutive days of no snow cover in areas with significant snow cover (Turner and Lawson 1978). This criterion, however, is used only for starting forest fuel moisture calculations and does not indicate the start of the fire season per se.

The United States National Fire Danger Rating System (NFDRS) (Deeming *et al.* 1977) does not have a set criterion for starting or ending the fire season either. Fuel moisture calculations are started four weeks before the first season is to start. A specific region will decide when the fire season is expected to start in their area, based on recent fire history. Simard *et al.* (1989) used a concept of burning-days to indicate the days of the fire season in areas with no snow cover. They define the fire season as starting after three consecutive days of maximum temperatures greater than 7.2°C.

After looking at various methods, we decided to use a slight variation in the CFFDRS definition of the start of the fire season. The chosen approach had the fire season start in an area after three days of maximum temperatures greater than 12°C.

In the CFFDRS and NFDRS there is no official end to the fire season nor to the calculation of fire weather indices. In Canada, a fire management agency may consider a fire season as being over at the end of October, when there has been a long time with little or no fire activity and low fire indices, or simply when seasonal employees' contracts terminate in the fall. Needless to say, these definitions were not suitable for our study. Simard *et al.* (1989) end the season with the reverse of the criteria they use to start it, that is, after three consecutive days of maximum temperatures below 7.2°C.

After studying the merits of several end of season indicators, we decided to use a modified temperature criterion adapted from the CFFDRS start criterion and the end of season criterion of Simard *et al.* (1989). That is, a fire season was considered over after three consecutive days of maximum temperatures less than 5°C. Temperature is a simple variable that has a strong annual cycle and can be a good and reliable indicator for a season's starting and ending times. Temperature simulation through GCM's also seems to be the part of the modelling process in which modellers have the most confidence.

Using our temperature criteria, we calculated the actual start and end dates of the fire season for each year. This was

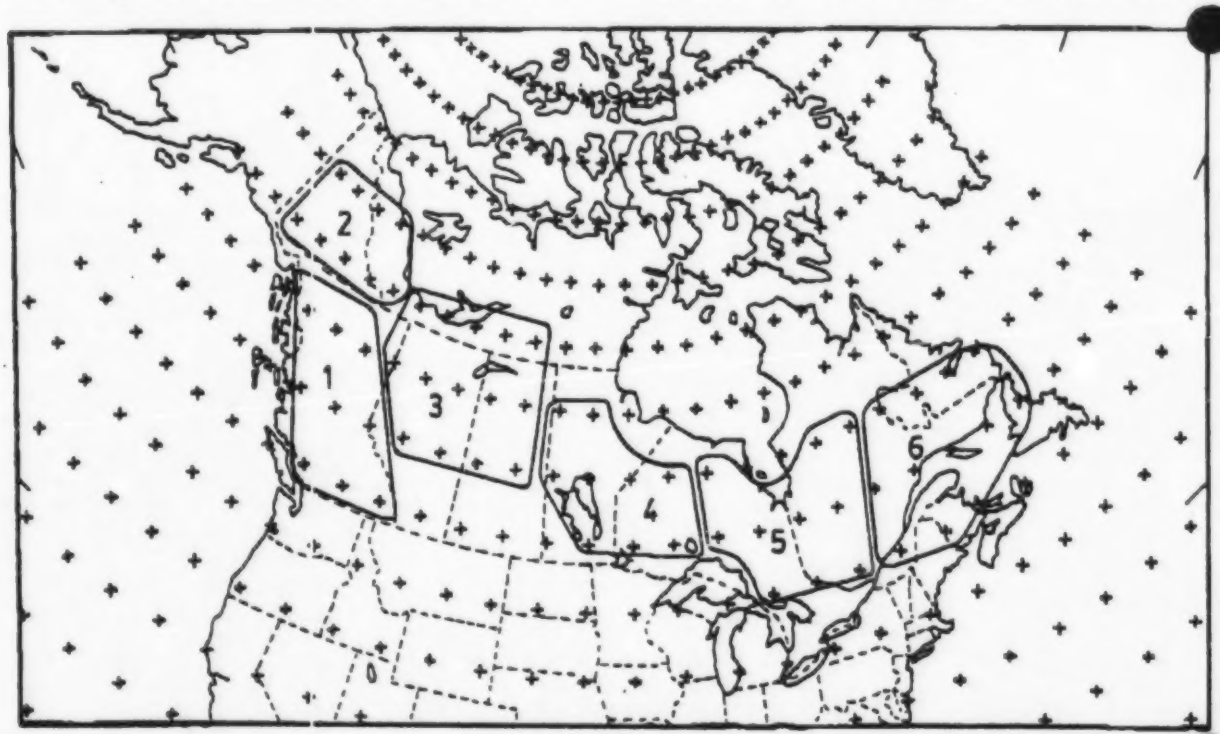

Figure 1. Gridpoints designating the six zones into which the forested region of Canada were separated. Each '+' marks gridpoint location in the GCM model.

done for each gridpoint for both the $1\times CO_2$ and $2\times CO_2$ data sets and also for each weather station. We averaged these values over the number of years in the data set (30 years for actual data and 10 years for each GCM scenario) to provide a mean value of fire season start and end dates.

Our first objective was to compare results from the $1\times CO_2$ model to the actual climate data from the weather station records. Comparison of values between those at individual weather stations and those at gridpoints were useless in this case due to the spatial resolution of the GCM. The model averages the weather in a large area around the gridpoint to create a value at a particular point. Unfortunately, the small geographical and climatic features at individual points were lost in this process. A thorough discussion of this problem of regional analysis of climate change impacts can be found in Cohen (1990). In order to make reasonable comparisons, a number of gridpoints must be averaged together and then compared to the averages from a group of weather stations taken from the same area. With this in mind, we divided our set of gridpoints located within the forested region of Canada into six zones (Figure 1) based loosely on geographical regions, climatic zones, and forested regions (Rowe 1972). We then compared calculated fire season length from the $1\times CO_2$ and $2\times CO_2$ model runs.

Results

The average start and end date of the fire season in each zone for the $1\times CO_2$ data and weather station data are listed (Table 1). The fire season starts about 30 days earlier when it is calculated from the actual data than it does in the $1\times CO_2$ case. This discrepancy will be explained later. We do, however, believe that the earlier starts calculated from AES weather station records approximately correspond to the times we would say the current fire season starts in the various zones. This satisfied us as to the validity of our fire season starting criteria.

The end of season as calculated from the weather records and the $1\times CO_2$ data set agreed fairly well (Table 1). The dates correspond to about the expected time for the end of the fire seasons in the specific zones with the exception perhaps of zone one.

We then compared the $1\times CO_2$ and $2\times CO_2$ data sets with each other, gridpoint by gridpoint, using a simple Student-t comparison. All gridpoints had significantly earlier starts in the $2\times CO_2$ scenario, with better than 99% confidence. The season in the $2\times CO_2$ world started an average of almost 20 days earlier. The $2\times CO_2$ fire season end also occurred later in the fall. This difference was less pronounced, however, averaging only about 10 days, but was still significant at a 99% confidence level for all but eight of the 61 gridpoints.

The start and end dates of the seasons were averaged over the six zones as before and compared in a similar manner (Table 2). There was a significant earlier beginning and a later end to the fire season for the $2\times CO_2$ scenario in all regions. The start averaged about 18 days earlier and the end averaged about 10 or 11 days later. Thus a lengthening of the fire season of almost 30 days is predicted on average.

Discussion

The discrepancy in fire season start dates (Table 1) is due to an artifact of the GCM. The later model start is caused by the temperature remaining at 0°C for a long period of time as it crosses from the freezing point. A plot of the average yearly temperature trend at a specific gridpoint illustrates this (Figure 2). When the weather cools in fall, the temperature corresponds to the end of season criteria before it reaches 0°C and thus, the end of season date is not changed. This effect is due to a connection in the model between reported screen temperature (the temperature 1.4 metres above ground) and the ground temperature. That is, when snow is on the ground but the atmospheric temperature is

Table 1. Average start and end of the fire season for $1\times CO_2$ scenario and weather station record

	Weather station Average					$1\times CO_2$ scenario Average				
Zone	Start	Std err	End	Std err	Season length	Start	Std err	End	Std err	Season length
1	APR 14	4.8	NOV 7	10	207	JUN 13	4.7	OCT 20	4.7	129
2	MAY 11	4.4	OCT 3	2.7	145	JUN 19	6.1	OCT 7	2.0	110
3	APR 27	1.8	OCT 17	1.9	173	MAY 30	3.5	OCT 16	2.2	139
4	APR 29	1.7	OCT 24	2.1	178	MAY 24	4.6	OCT 27	2.3	156
5	MAY 1	2.7	OCT 23	2.6	175	MAY 27	4.3	OCT 30	2.8	156
6	MAY 3	3.3	NOV 3	3.7	184	JUN 4	5.1	NOV 1	4.1	150

Table 2. Average differences in season starting and ending dates between $1\times CO_2$ and $2\times CO_2$ scenarios for each of the six zones in the forest subset (each t-value has 18 degrees of freedom).

	Start of season		End of season		Season length		Percent
Zone	Diff.[1]	t-value	Diff.[1]	t-value	$1\times CO_2$	$2\times CO_2$	increase
1	−26.5	−4.70	24.5	2.79	129	180	39
2	−20.2	−2.90	9.6	3.97	110	135	28
3	−14.4	−3.18	9.0	3.25	139	163	16
4	−15.7	−2.44	9.3	2.68	156	181	16
5	−14.4	−2.45	11.9	3.08	156	182	17
6	−17.1	−2.55	12.1	2.06	150	179	19
Canada	−17.8	−6.25	12.3	4.44	138	168	22

[1]Difference is the $2\times CO_2$ starting or ending date average minus the $1\times CO_2$ starting or ending.

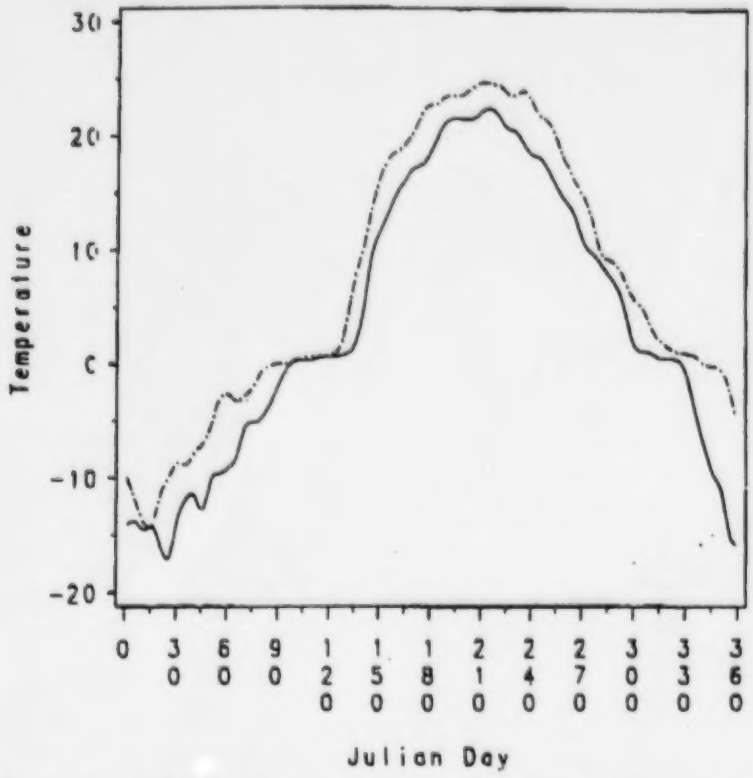

Figure 2. A plot of 10-year averages of maximum temperature for both the $1\times CO_2$ and the $2\times CO_2$ datasets from a gridpoint in Saskatchewan.

above freezing, the screen temperature is held down by the ground temperature, which stays at zero until all snow has melted. Because spring temperatures in both scenarios warm at roughly the same rate, the GCM develops a similar problem in both runs of the model and it takes approximately the same amount of time in both scenarios to overcome this screen/ground temperature coupling. Examination of temperature trend plots (Figure 2) verify that this is generally the case across the entire country. Thus, the effect is present to approximately the same degree in both runs of the GCM and, comparing the two runs, the effect only causes an equal shift in the absolute length of the season in both cases. While this does not affect comparisons in the present study, we must note the phenomenon with respect to the absolute fire season length as calculated from the GCM data.

Results (Table 2) show that there are absolute and statistically significant differences in the start and end dates of the fire season between the $1\times CO_2$ and $2\times CO_2$ data sets. Average standard errors (not shown) of fire season start and end for all zones were about 3 or 4 days in both scenarios. There appear then to be no significant differences in variability of fire season length between the scenarios.

The lengthening of the fire season is greatest for zone one which is essentially the province of British Columbia. Results suggest that the fire season in B.C. in a $2\times CO_2$ world will be just over 50 days longer, with the increase split evenly between spring and fall. British Columbia's present climate already makes it the area in Canada with the most significant fall fire season (Harrington 1982).

In zone three, primarily the forested sections of Alberta and Saskatchewan, our analysis indicates the fire season will start about two weeks earlier than at present. This is of concern especially in Alberta where, historically, the majority (63%) of the area burned has occurred in May. Thus an earlier start to the fire season would necessitate earlier dates for fire fighting preparedness. The extra length of the spring fire season may be slightly offset, however, by the shorter length of daylight in the earlier part of the season. The number of hours of sunlight during the day affects the drying time of exposed fuels; the shorter days earlier in the season would not allow as much drying to take place.

The results also seem to suggest a longer fall fire season in Eastern Canada. The fire season in zones five and six, already late ending, could be extended even further into fall. This would increase the period between leaf fall and the end of the fire season and could give rise to a more pronounced fall fire season similar to that of the Eastern United States.

Overall, a lengthening of the fire season would cause a larger demand on fire management agencies, as they would have to maintain a state of readiness for a longer time. Weather monitoring and the hiring of seasonal workers for fire suppression would have to start earlier and end later in the year.

With an earlier start and later end to the fire season, there will, of course, be a longer "middle" to the season. With the increased temperature anticipated for this time, much drier forest fuels can be expected if rainfall patterns do not change significantly. However, confidence in rainfall

simulation by GCM's is much lower than that of temperature at this point in time. Rough estimates from the Canadian Climate Centre GCM indicate an increase in total annual rainfall across Canada in a $2\times CO_2$ world. This increase is not temporally uniform but seems to occur mostly at the start and end of the fire season. Rainfall amounts in the summer months in the $2\times CO_2$ scenario remained relatively unchanged from amounts in the $1\times CO_2$ scenario. This agrees with some of the findings of Street (1989). We did not, however, look at the frequency of rainfall events in the summer. It has been shown (Flannigan and Harrington 1988) that area burned in Canada is well correlated with sequences of dry days, and changes in this regard may play a key factor in the forest fire situation in a $2\times CO_2$ world. During an extended summer there is also the possibility of increased drought periods and consequent extreme fire danger.

We predict the length of the fire season will increase by an average of 22% across Canada in a $2\times CO_2$ world. If we assume that the number of fire starts and area burned are proportional to, or are at least positively correlated with, the fire season length, then even without considering the extra drying effect of higher temperatures on forest fuels, the forest fire situation in Canada would become more severe.

Summary

Using the Canadian Climate Centre's GCM, we found that the fire season length could increase by an average of 22% or 30 days across Canada in a $2\times CO_2$ world. The increase would be most pronounced in BC where the fire season could increase by 51 days or 39%. The increased fire season length would be due to the higher temperature regime across Canada over the year. It is unclear at this point, due to the limitations of the GCM, if the accompanying change in the rainfall regime will compensate for the effect of increased temperature on fire danger, or amplify it, or indeed if there will be any large change in rainfall patterns over the summer months. We do not intend to suggest that increased fire season length and the accompanying increase in forest fire occurrence and severity would be catastrophic for the Canadian forest. However, increases in the severity of fires and in fire occurrence frequency, and thus fire load, could make forest management a more difficult task. From a fire protection and suppression point of view, this could translate into significantly increased resource commitments by fire fighting agencies.

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Appendix

The list of the Atmospheric Environment Service weather stations used in comparing the $1\times CO_2$ output from the GCM to actual observations.

Station location	Zone no.	Station location	Zone no.
Victoria, B.C.	1	Dawson, Yukon	2
Smithers, B.C.	1	Whitehorse, Yukon	2
Williams Lake, B.C.	1	Fort Simpson, N.W.T.	3
Cranbrook, B.C.	1	Fort Smith, N.W.T.	3
Fort Nelson, B.C.	1	Yellowknife, N.W.T.	3

Station location	Zone no.	Station location	Zone no.
Rocky Mtn. House, Alta.	3	Earlton, Ont.	5
Fort McMurray, Alta.	3	Kapuskasing, Ont.	5
Slave Lake, Alta.	3	Kapuskasing Airport	5
Whitecourt, Alta.	3	Timmins, Ont.	5
Cold Lake, Alta.	3	Chalk River, Ont.	5
North Battleford, Sask.	3	Maniwaki, Que.	5
Prince Albert, Sask.	3	Bagotville, Que.	5
Hudson Bay, Sask.	3	Val D'Or, Que.	5
Winnipeg, Man.	4	Roberval, Que.	6
Gimli, Man.	4	Campbellton, N.B.	6
Dauphin, Man.	4	Fredericton, N.B.	6
The Pas, Man.	4	Truro, N.S.	6
Thompson, Man.	4	Gander, Nfld.	6
Landsdowne House, Man.	4	Goose Bay, Nfld	6
Kenora, Ont.	4		
Sioux Lookout, Ont.	4		
Thunder Bay, Ont.	4		

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Fire - Climate Change Hypotheses for the Taiga

R.W. Wein and W.J. de Groot [1]

1. Introduction

Residents of Canada and other northern circumpolar countries are concerned with the scenarios of climate change since Global Circulation Models predict that global warming over the next 30-50 years will be most evident in the northern regions (Bolin et al. 1986; Roots 1989; Maxwell 1992). Climates in the north would be supportive of much more southern types of biotic systems (Emanuel et al. 1985).

We recognize that fire may be the most important (widespread) driving force in changing the taiga under climatic warming conditions. At the time of burning, CO_2 is released to the atmosphere where this greenhouse gas will act as a feedback loop to global warming. In addition, CO_2 release continues for one or more decades after the fire because of higher decomposition rates of organic matter, particularly in northern soils. As for climate change stresses on the biota of the ecosystem, it is our hypothesis that these energy and nutrient conservative ecosystems change very slowly even if the climate changes; however, fire can be a triggering event to remove species that are poorly adapted to the new climate regime. More importantly, fire modifies the physical environment and disrupts the population dynamics to such an extent that there can be strong changes in species abundance and new species may invade the burned area.

2. Wildfires in the Circumpolar Taiga

More than ever before Canada is exploiting the boreal forest so Canadians, and most recently Albertans, are recognizing the extent and importance of this biological zone. The taiga in Canada and Alaska is about 373×10^6 ha of the circumpolar total of 1214×10^6 ha. Russia has almost triple the amount of commercial forested land when compared to North America.

Fire is the most widespread agent of unplanned change in the boreal zone (Wein and MacLean 1983, and more recently, Johnson 1992); fire rapidly modifies the carbon budget not only of the frequently dry upland forests but also of the forests with deep organic soils, particularly after periodic severe droughts. This is not to negate other disturbances

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(Overpeck et al. 1990) of disease or insects (there is an increased probability that fire may follow these disturbances as well) and especially harvesting, which covers millions of hectares annually, but periodically fire is the overriding force.

In the past decade there has been an unprecedented increase in the annual area burned by wildfires in Canada (Van Wagner 1988). The 10 year running mean of annual area burned ranged from 1.5×10^6 ha in the 1930s and 1940s to 1.0×10^7 in the late 1970s. The years 1981 and 1982 were spectacular years with values of about 5.0 and 5.5×10^6 ha, respectively. These years were overshadowed by the burned area in 1989 of 7.39×10^7 ha, 3.28×10^6 ha of which was in northern Manitoba (Hirsch 1991).

To add to the temporal pattern above it is instructive to understand the spatial dimension of past fires. During most years, fires are scattered across the boreal zone of the circumpolar north, for example in the year 1980, fires were ignited across much of the western Canadian boreal forest. In other years there are concentrations of fires at the regional level.

Tab.1. The extent of the boreal (taiga) zone in the circumpolar North (in 10^6 ha and % of circumpolar total). Extracted from Kuusela (1992).

	Russia	Canada/ Alaska	Norway/ Sweden/ Finland	Total
Partly forested	790 (65)	373 (31)	51 (4)	1214
Closed forest	673 (73)	202 (22)	44 (5)	920
Commercial forest	450 (71)	149 (23)	40 (6)	639

Tab.2. Selected years with major regional fires in circumpolar taiga

Year	Location	Total Area (10^6 ha)	Area Burned		Comments	Reference
			Total (10^6 ha)	%		
1981	Northern Alberta	32 (11)*	1.36	4 (12)*	29 fires over 200 ha	Delisle and Hall (1987)
1987	Daxinganling, NE China	8	1.33	17	at least 4 major fires joined	Yun-Qian and Ji-Zhong (1989) Di and Ende (1990)
1989	Northern Manitoba	36 (19)*	3.28	9 (17)*	60* fires over 5,000 ha	Hirsch (1991)

* numbers in brackets represent greatest concentrations of multiple fires as estimated from maps

3. Wildfire Scenarios under Global Warming

A few Canadian studies have explored possible wildfire scenarios. Street (1989) provided the first Canadian study using a monthly average approach to expected weather changes in Ontario. He used a 2 x current atmospheric carbon dioxide concentration (CO_2) scenario (typical of climate change models) to estimate temperature and precipitation changes, and used these values to calculate the subsequent change in average monthly burning conditions, or the monthly Fire Severity Rating (FSR) (Williams 1959). He determined that the fire season would increase in length, and the fire regime would increase in severity as a result of doubling atmospheric CO_2 levels. The most severe portion of the fire season would also shift to late summer.

Although averages usually provide a good indication of trends by removing the statistical noise of variability, in this situation, the greater daily variability in burning conditions is more critical than the average change. For instance, the average increase in fire intensity may only be slight, but it can result in a large number of moderate intensity days becoming high or extreme intensity days. Over 90% of all fire losses occur in the high to extreme range (Pyne 1984), so even a doubling of these days (i.e., from 5% to 10% of all days) can have disastrous results. Using averages can mask this effect by indicating only a minor average increase within the moderate range. Stocks (1990) states that GCMs indicate an increase in the occurrence of extreme weather events. This only supports the fact that monthly averages are too coarse for measuring climate change effects on wildfires.

This point was mentioned by Flannigan and Van Wagner (1991) who opted for using a seasonal severity rating (SSR) (Van Wagner 1970). The SSR is a direct function of the daily Fire Weather Index value (Van Wagner 1987) and was originally designed to indicate the difficulty in suppressing a fire. It can be used for spatial and temporal comparison of fire danger (e.g., Harvey et al. 1986) which makes this ability a useful tool for modelling climate change effects on wildfires.

Flannigan and Van Wagner (1991) used a similar approach as Street (1989) by developing a $2xCO_2$ scenario. They selected six stations across Canada to compare changes in wildfire activity using the SSR and GCM estimates. Although their study did not take into account the effect of a longer fire season or dry early springs, their results showed a conservative increase of about 50% in SSR and a commensurate increase in area burned. They also found that the greatest increase occurred for the lowest SSR values. In other words, the net effect was not just an average increase in all daily SSR values, but a change that increased with decreasing SSR.

The same study noted that 85% of the historical area burned in Canada occurs west of Lake Nipigon. Therefore, it was suggested that the greatest proportion of any increase in area burned due to climate change will likely occur in the west. Although a 40% increase in area burned appears possible, Flannigan and Van Wagner (1991) also point out that there has already been a 50% increase since 1970 (Van Wagner 1988).

Surprisingly, the Flannigan and Van Wagner (1991) study showed that changes due to precipitation anomalies had little effect on SSR values. All stations received increased precipitation amounts from the GCM models (a typical global warming scenario), which were distributed according to historical observed sequences. This resulted in little effect on SSR because the cumulative precipitation amount is much less important than the sequence of precipitation events. If there is a greater occurrence of extreme weather events associated with climate change as stated by Stocks (1990), it is possible that extended droughts will interfere with regular precipitation patterns and cause increased wildfire problems.

4. Changes to Fuels on the Landscape

A secondary effect of climate change on wildfire is the role it plays in vegetation distribution, or more aptly, fuels distribution. The Canadian Forest Fire Behaviour Prediction System (Forestry Canada Fire Danger Group 1992) illustrates the wide range in fire characteristics that result from different fuel types. Fuels can also affect fire occurrence, rate of spread, fuel consumption and fire intensity.

Obviously, climate change will result in different temperature and moisture regimes which will adjust the present population boundaries of plant species. Several studies have presented estimates of vegetation shifts, including Emanuel et al. (1985) who predict that the boreal forest will shift northwards into the tundra and shrink in size by about 37%. Kauppi and Posch (1988) estimate the circumpolar boreal forest to shift north about 500-1000 km. Wheaton et al. (1987) used two GCMs to estimate a southern shift of the boreal forest by 250-920 km north, and a northern boundary shift of 80-730 km north. Sargent (1988) estimates a loss of about 100×10^6 ha. in the boreal forest as it shifts north.

Some scientists studying the vegetation of more humid climates, suggest the shift of vegetation regions is expected to be gradual. Solomon (1986) explored forest succession in eastern North America using a stand-level model. He predicted that temperature and precipitation changes resulted in distinctive dieback of trees that were near the boundaries of their natural range. The southern coniferous-deciduous boundary had a less distinct dieback with a rapid recovery of deciduous species. The northern transition areas showed vegetation changes that were sharp as boundary species were replaced with ingressing species. The new species were also sharply replaced by other species shifting northwards as climate change progressed. These responses continued for up to 300 years following the simulated climatic changes.

The above study and others focus on vegetation changes that occur from differences in growth regimes. However, these same climatic changes will also create different fire regimes. In the continental areas of the taiga, climatically stressed and killed vegetation will provide quantitative and qualitative changes in fuel. On most landscapes of the taiga of North America most of the branches and all of the boles of fire killed stands fall to the front floor within one or two decades and decompose slowly over many more decades. Under increased drought more of this fuel becomes available for burning during a second fire. In addition, under increased drought stress more soil organic matter becomes available from not only forest floors but also from wetland areas that support trees (eg. treed bogs) and other non-treed bog types.

5. CO_2 Feedback Loop to Global Warming

We have emphasized the importance of fire in the northern circumpolar forest but it has been estimated that global vegetation burning and forest conversion to agriculture releases 4 to 6×10^{12} kg of carbon to the atmosphere annually; of this, the circumpolar countries contribute only 1.2-1.8% and Canada contributes 0.50-0.75% (Crutzen and Andreae 1990). Stocks (1991) provided more detailed estimates of carbon release for the circumpolar boreal forests over the past decade. He estimated the burned area at 5.6×10^6 ha with Canada contributing 3.0×10^6 ha. If 25×10^3 kg ha^{-1} is an average level of fuel consumption and if 50% by weight of this fuel is carbon, then the carbon release was 7.0×10^{10} kg for the

circumpolar countries and 3.8×10^{9} cg for Canada. The reader is referred to Cofer et al. (1990, this volume), Houghton (1991) and Levine (1991) for further details.

These average values are valuable but it must be emphasized that burns far exceed these averages in some years and there are many other factors not included in these calculations. There is much variability of fire intensity from hour to hour and there may be large unburned or lightly burned patches within burned areas (Eberhart and Woodard 1987). Deep burning fires in exceptionally dry years in forests with thick soil surface organic matter layers and in peatlands are not included. Multiple burning of areas is also not considered; during the first fire, trees are killed but not consumed, but in a second fire, the dry trees would be oxidized to release considerable carbon dioxide. In addition, the accelerated post-fire rate of carbon release by decomposition can contribute as much carbon to the atmosphere as during the fire. A.N.D. Auclair (personal communication) conducted a simulation experiment and concluded that emissions during and after biomass burning may have been a significant feedback loop to global warming in the past 10-15 years. Release from tropical deforestation is very rapid and has been emphasized in the literature but northern ecosystems continue to release CO_2 for one to two decades after the fire because of accelerated decomposition under warmer soil conditions.

In calculating global carbon budgets the scaling problems become even greater. Fire is a major force in the Eurasian boreal forest (Stocks 1991) yet, until recently, few data have been available on carbon release rates from those vegetation types which tend to burn with surface fires rather than high intensity crown fires as in North America; even the spatial and temporal nature of burned areas were not readily available.

6. Forest Fires and the Carbon Cycle

Although determination of carbon release levels by fire is of major interest in modelling the effects of fire on climate change, it must be remembered that forest fires are a natural event. Therefore, carbon release should be viewed as part of a larger ecological process, in this case it is carbon cycling.

Kurz et al. (1991, 1992) provide the first carbon budget model that deals with carbon cycling on a Canada-wide scale. This model has incorporated the effect of fire as a disturbance in terms of releasing carbon, as well as altering the rate of carbon uptake by vegetation growth following fire.

Using this modelling approach, disturbances such as fire are viewed as altering the rate of change in the net carbon balance rather than as just a source of release. The model uses three major biomass pools: forest biomass, forest soils, and forest products. There are five disturbance types including wildfire, stand mortality by insect, clearcut logging without slash burning, clearcut logging with slash burning, and partial cutting (Kurz et al. 1991, 1992).

The model uses a 10-year average of area burned during the 1980s to spatially allocate disturbance by fire. In this manner, the most recent fire statistics are utilized, and the wide fluctuations in yearly statistics is dampened to accommodate long-term averaging calculations. The level of fire impact is contained in disturbance matrices which describe the reallocation of carbon at the time of disturbance.

The disturbance matrices contain 12 carbon sources and 16 carbon sinks. Matrix coefficients quantify the proportion of carbon that is moved from the source to the sink. There is a separate disturbance matrix for each of 41 spatial units and disturbance types.

Operating the model for a one year period (1986) indicated that wildfire in Canada caused a release of 18.7 Tg of carbon into the atmosphere from forest biomass, and 14.3 Tg of carbon released into the atmosphere from forest soils (Kurz et al. 1992). Wildfire also caused a transfer of 20.9 Tg carbon from forest biomass to forest soils. To put these amounts into perspective, the net growth of forest biomass caused a carbon accumulation of 92.0 Tg, while peatlands acquired an additional 26.2 Tg of carbon. The Canadian forest sector had a calculated net carbon accumulation of 78.6 Tg for 1986.

Although the carbon released by fire into the atmosphere is small compared to the amount sequestered by biomass growth, it is still the major contributor of atmospheric carbon in the forest sector. However, it is not known what the net effect of wildfire is on the carbon budget. For instance, if wildfire was reduced by 50%, what difference would this have on the overall rate of carbon accumulation in forest biomass? Similarly, how would carbon accumulation rates change in forest biomass if the area burned by wildfire was doubled? Also, what effect would this have on the important role fire plays in shifting forest biomass carbon to the soil?

7. Vegetation Responses

Many predictions of biotic changes under climate change have and will be raised for discussion and testing but we will address only vegetation responses. Vegetation types, especially in nutrient-limited and energy-limited northern ecosystems, are conservative and show little change over time. Even under gradually increasing air temperatures the responses could be subtle, but increased growth and reproductive capacity might be recognized as early changes. The response of vegetation types could be much more dramatic following fire. Fire not only removes part of the vegetation but also changes the energy and nutrient budgets dramatically. Changes in species abundances and even species numbers will be highly probable. Our research group has explored several case studies that illustrate these points.

We have examined an analogue of climate change in northern marshes by modifying moisture regimes (and indirectly temperature) of the vegetation. We moved soil-vegetation blocks upslope to higher elevations where flooding was less frequent (Hogenbirk and Wein 1991). Little change in species abundance occurred over a two year period even though drought stress occurred. By adding the stress of fire there was a strong shift to opportunistic Eurasian weedy species (*Tanacetum vulgare* L., *Sonchus arvensis* L., *Cirsium arvense* [L.] Scop., *Chenopodium album* L.) especially under warmer soil conditions (Hogenbirk and Wein 1992).

A somewhat similar example of the impact of severe fire at the arctic forest-tundra boundary has been studied recently by our team. It is well established that this ecotone is strongly controlled by climate; tree advance and retreat has occurred periodically over centuries and millennia as climate changed. Over the short term of two to five decades tree establishment in the tundra is minor; however, after a 1968 deep-burning fire near Inuvik, Northwest Territories and a subsequent climatic warming trend, *Populus balsamifera*, and *Betula papyrifera* moved well beyond their pre-fire locations (Landhäusser and Wein 1993). In addition, Olsen (1993) has determined experimentally that the post-fire tree establishment success was not strongly influenced by changed moisture regimes (+30%, normal, -30%) and/or changed temperature regimes (+3°C, normal); the main overriding force in increasing tree seedling establishment success and growth was increased fire severity (deeper burning).

The above studies consider only one fire but under climate change scenarios an increased probability of fire may lead to several fires in less time than normal. Multiple fires will lead to rapid and stepwise rates of change, replacing species that are poorly adapted with new combinations of species that flourish under the new environmental conditions. Plant species that disseminate propagules over wide areas have high light requirements, rapid growth rates, reach maturity quickly, and will be most successful in moving northward.

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for Todd. Mark

KPMG

Project Report

ALBERTA FIRE REVIEW '98
ADDENDUM TO FINAL REPORT

Prepared for

Alberta Forest Protection Advisory Committee
Edmonton, Alberta

Submitted by

Todd Nash

Edmonton
February 15, 2000
37108/TN/dd

Alberta Fire Review '98
Addendum to Final Report

This addendum is prepared to present additional information and analysis carried out subsequent to the December 14, 1999 final report. Information and analysis included relates to the following items:

- Level of commitment to the Forest Protection Program by sectors outside of the Land and Forest Service (LFS).
- New initiatives for improvement carried out by sectors outside of the LFS.
- Policy issues related to the level of involvement by sectors outside of the LFS.
- Specific items identified in the original terms of reference as identified by the steering committee as requiring consideration.
- Additional items identified by the steering committee

The information items are presented in the following sections. Results of this additional information and analysis do not affect conclusions or recommendations presented in the report.

A. Resource commitment by sectors outside the LFS

Exhibit 1 summarizes estimates of resources committed to the forest protection program by sectors outside of the Land and Forest Service. The "outside" sectors are grouped as the forest industry, oil/gas industry, local governments and other sectors (mining, rail, power, etc.) These estimates are based on interviews, discussions and additional information provided by individual firms. The estimates are extrapolated to each sector as a whole in an effort to portray the scale of commitments and involvement and are not intended to represent an exact accounting of resource deployment. The information presented represents an approximation of resource commitments over and above those that the Crown manages and/or funds.

Exhibit 1
Estimate of annual activity/resource commitment by sectors outside of the LFS

Resources	Forest industry	Oil/gas industry	Local government	Other sectors
Human resources	• 76 man months Initial Attack and Overhead Team contribution/ support. • Four to six - 8 man fire crews maintained on standby. • Heavy equipment operators as required.	• 6 man months Initial Attack and fire suppression support.	• 6 man months overhead team support.	• Occasional provision of experienced fire staff when available.
Equipment	• Heavy equipment available when needed. • Fireline tools, equipment as per agreement. • Light rotary wing aircraft hired as required.	• Heavy equipment made available when needed. • Fireline tools and equipment as per agreement or other specification.	• Occasional provision of water trucks and watertanks.	• Occasional provision of heavy equipment as required and when available.
Funding	• Estimate of $650,000 annually towards human resources. • Estimate of $180,000 in R/W costs.	• Estimate of $35,000 towards human resources.	• Not Available.	• Not Available.
Other	• Personnel training. • Maintaining readiness. • Communication.	• Personnel training. • Maintaining readiness. • Communication.	• Not Available	• Not Available

Information and estimates applied to exhibit 1 largely reflect information and behaviour in the 1998 and 1999 fire seasons. It should be noted that during low fire seasons, the commitments and contributions to the forest protection program could be quite different.

B. New initiatives by sectors outside of the LFS

Many of the new initiatives identified with the Land and Forest Service involve sectors outside of government in direct and indirect ways. Examples of this are the establishment of the Alberta Forest Protection Advisory Committee, the development of landscape fire management approaches and the implementation of LFS/industry liaison positions at local areas.

In addition to these initiatives led by the LFS, a number of other initiatives can be considered as potential improvements to the forest protection program overall. These are:

1. Supplementary fire crews

A number of forest products firms have endeavored to supplement the provincial fire fighting capability by maintaining initial attack and sustained action crews themselves, in preparation for new wildfire starts. Typically, these crews are organized and brought on standby when hazards and risk are higher and costs are covered by the company. Some of these crews are employed throughout the fire season. If and when crews are used on fire suppression activities, costs associated directly with a wildfire are typically reimbursed from the forest protection budget by government.

2. Supplementary detection

While the forest industry (and all sectors involved in field operations) occasionally detect fires coincidentally with their day to day activities, a number of firms have established initiatives to enhance detection efforts during periods of critical hazard and risk.

Elements of this initiative include:

- Adding fixed wing and/or rotary wing "loaded" aerial patrols during periods of high hazard and risk.
- Developing and maintaining communication and reporting protocols for industry staff to report fires when detected.

3. Partners in Protection

Though Partners in Protection, as a program, is led by the Land and Forest Service it also involves local governments and industry participants. This program is truly an example of productive partnerships that work. Led by the LFS, education and prevention initiatives are implemented through projects such as:

- Hazard reduction activities surrounding communities.
- Community education regarding fire prevention.
- Education and hazard reduction related to homes located in the wildland/urban interface.

C. Incident command system

Over the course of interviews with wildfire experts and upon an evaluation of fire management alternatives, the concept of using the Incident Command System in Alberta was addressed.

The Incident Command System (ICS) was developed in the U.S. primarily for the purpose of managing multiple jurisdictional issues and for coordinating more than one agency responsible for fire control. Given the situations in Alberta of having one primary forest protection agency and given the direction of government to maintain this single primary agency approach to forest protection, the ICS is not relevant. We would recommend against adopting the ICS in Alberta.

D. Air operations in large fires

Utilization and effectiveness of aircraft on large fires was flagged as an issue by the steering committee for both the 1998 and 1999 fire seasons. Attempts were made to collect data on aircraft utilization on large fires in 1998 as well as in 1995 and earlier. The intent was to compare aircraft utilization in the different years and evaluate differences. It was predicted that aircraft utilization, especially light and medium rotary wing aircraft, dramatically increased in 1998 and related to the need to transport fireline crews from centralized base camps to the fireline, and to transport meals from base camp to firefighters on the line.

Data was not available from the LFS for this analysis, largely as a result of difficulties associated with data entry to the FIRES system. The lack of data makes it impossible to

analyze the issue, though it is still a matter in need of investigation. We recommend that the LFS follow-up on this issue by compiling aircraft utilization statistics by fire and analyzing differences between fire seasons.

E. Overhead team resources

An issue respecting the level of training and expertise, particularly with overhead positions, was identified and analyzed in Part I of the report. Recommendations on the level of firefighter resources needed in the province were made in Part II of the report. While specific recommendations were not made regarding the optimum level of overhead resources needed in Alberta, it was recognized that the province's capabilities regarding overhead team members needed to improve.

Based on ratios of overhead team members to firefighters in other jurisdictions, and considering past ratios in the Land and Forest Service, estimates of the level of overhead team resources can be presented for consideration by the LFS.

a) Fireboss I and II members—approximately 110 to 130 fireboss I and II certified individuals should be available if the firefighter force in Alberta is increased according to recommendations 49 and 50. Individuals at the FB I and II levels in 1999 were reported by the LFS as 96. Sixty Fireboss I and II positions were reported in 1997.

b) Sectorboss members—approximately 155 to 175 sectorboss certified individuals should be available if the firefighter strength is increased as recommended. Certified individuals at the sectorboss level in 1999 were reported by the LFS as 170. Eighty-two such positions were reported in 1997.

c) Other overhead team members—positions such as Plans Chief and Service Chief follow the level of resourcing established by fireboss and sectorboss positions. Given that current estimates for overhead team member levels presented in Parts "a)" and "b)" (above) are equal to or greater than levels in 1992 and 1993, an estimate of the number of service chief, plans chief and other overhead members required would approximate 1993 levels.

F. Alberta Firenet initiative

The Alberta Firenet initiative was addressed in Part 1 of the report and it was recommended that the initiative be considered a priority in the 1999/2000 fiscal year.

This initiative is critical to the success of the forest protection program. An adequate communication system is essential for safety and efficiency purposes, particularly considering the increased level of participation by industry and imported resources.

The current radio communications system is insufficient to meet the demands of forest protection today, and the task force dealing with this issue have made some very valid and constructive recommendations. This initiative must be considered a high priority.

G. Fire Management Agreements (FMA)

As the issue of fire management agreements was assessed as part of the program review, a concern was raised regarding the limitation of liability in quota fire control agreements. This issue appeared to be limited to specific circumstances rather than representing a provincial level program issue.

The concern expressed was that liability for damages caused by quota holders in the course of carrying out prescribed burning is not limited in any way, as it is for FMA fire management agreements. Should a prescribed burn run out of control, the quota holder would potentially be liable for all damages, even if the prescribed burn was approved by the LFS and the burn carried out according to all terms and conditions. This is in contrast to FMA holders carrying out the same activity. FMA holders have a limited liability clause in their fire management agreement which protects them in the event of escaped fires.

Most! A F/C Agreement must be entered into.

Surpina does not have a F/C Agreement.

There is the possibility that excessive risk to quota holders impacts the use of this silvicultural tool. While this issue was brought up in a very focused/narrow context, it warrants further investigation by the LFS. Quota holders interviewed, who recognized this issue, strongly believe that a new and more comprehensive fire management agreement with quota holders needs to be developed.

H. Enhancements to the Forest Protection Program

Work is currently being carried out by the Forest Industry Subcommittee regarding the definition of forest protection activities that are over and above mandated responsibilities. This work will support the recommendation made in part 2 (recommendation 34) that protection charges be reduced for companies that carry out activities aimed at reducing the risk of loss due to wildfire. The forest industry strongly supports a policy specifying that protection charges be reduced in recognition of extra forest protection work and the associated costs incurred by industry. A suggestion is that eligible work, as defined by

← "No generic templates for FMA & Q/H's
- Basic vs enhanced requirements
- Climate, other factors & "partners in protection"

see page # 217 of the Final Report

the Land and Forest Service, be credited towards protection fees in the following fiscal year.

In addition to reducing protection charges as an incentive for enhancements, other possibilities exist to encourage industry initiatives in the program. One possibility is the application of carbon credits to companies that carry out additional forest protection activities or that participate in effective forest prevention programs (i.e., under the Partners in Protection program). Such an opportunity would potentially benefit sectors such as oil/gas, mining, utilities and other, in addition to benefiting the public. Such opportunities would need to be discussed with the federal government.

I. Internal LFS communications

The issue of internal communication was addressed in Chapter IX of the final report as an area related primarily to the clarification of roles and responsibilities throughout the organization. It is believed that clearer roles, and more direct lines of accountability and authority will enhance internal communication. This is also addressed in Chapter XVI—"Organization And Structure", whereby accountability and responsibility can be linked to communication.

Internal communization is accomplished in a number of ways within the LFS including:

- Circulation of paper memorandum, directives and policy statements.
- Distribution of policy and procedure manuals.
- E-mail messages.
- Internet postings.
- District and regional meetings.

There is no evidence to suggest that the <u>means</u> of communication is an issue within the LFS. Communication naturally breaks down when individuals are unsure of their role, or are unfamiliar with their responsibility and accountability. Clarification of these critical items will foster improved communications.